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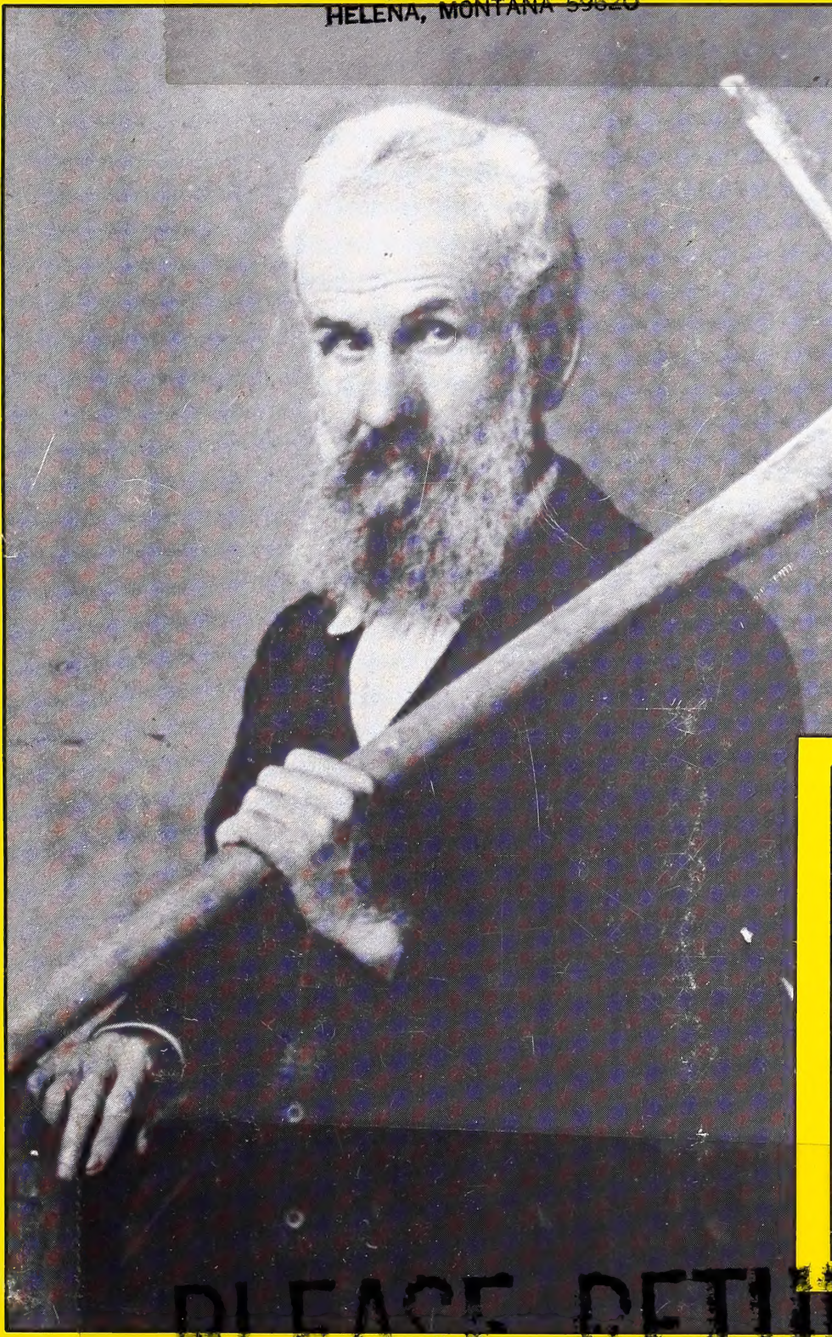

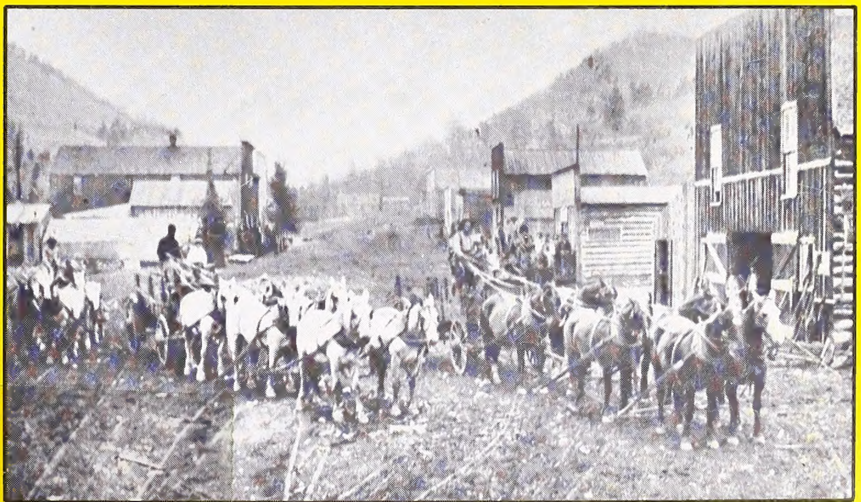

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Final Environmental Impact Statement

MONTANA DEPARTMENT OF STATE LANDS
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Type of Statement: Final Environmental Impact Statement

Lead Agencies:

State of Montana, Department of State Lands
U.S. Department of Agriculture, Forest Service

Proposed Action:

Approval of 1,050-ton-per-day gold mining and milling project in Jardine, Montana. The project is a joint venture of the American Copper and Nickel Company and the Homestake Mining Company.

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Cover Photos: (Clockwise from top) The Bear Gulch Hotel around 1900. The Jardine school house; photo taken between 1910 and 1920. Freight wagons in the main street of Jardine, circa 1900. "Uncle Joe" Brown pioneered gold mining in Bear Gulch and Jardine. Brown and three other men recovered $1,800 in gold dust from a river bar at the mouth of Bear Gulch in 1866. (Photos courtesy of Bill and Doris Whithorn, Park County Museum, Livingston, Montana.)

Final

Environmental Impact Statement

April 1986

Montana Department of State Lands

Dennis Hemmer, Commissioner

U.S. Forest Service
Gallatin National Forest

Robert E. Breazeale, Supervisor

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Preface

Since the publication of the draft EIS, the JJV has amended its application in response to the agencies' environmental analysis and the public's comments on the draft EIS. Among the changes made are:

1) an employee transportation and traffic-reduction plan for the Jardine Road,
2) use of sediment control practices (best management practices),
3) relocation of the septic tank and drainfield further from Bear Creek,
4) separation of potentially toxic liquid wastes from sanitary wastes,
5) provisions to prevent seepage of slurry water from the mine,
6) slurry pipeline specifications for withstanding corrosion and earthquake-induced stresses,
7) provisions for spill control and leakage detection,
8) provisions to dispose of the tailings from the cyanide circuit in the lined tailings dump only,
9) revised water use requirements, including identification of the point of diversion for the surface water supply.
10) a revised mine access road proposal, and
11) a plan to monitor wildlife use of the tailings area and fence the seepage collection pond.

These changes are described in Chapter I and elsewhere in the final EIS. Other changes have been made in the final EIS. The two mine-access alternatives from the Jardine Road have been deleted; Chapter I--Alternatives provides an explanation for this change. The final EIS also provides an analysis of alternative power line corridors. In addition, the agencies' preferred alternatives, including mitigating measures, are identified in the Summary and in Chapter I of the final EIS.

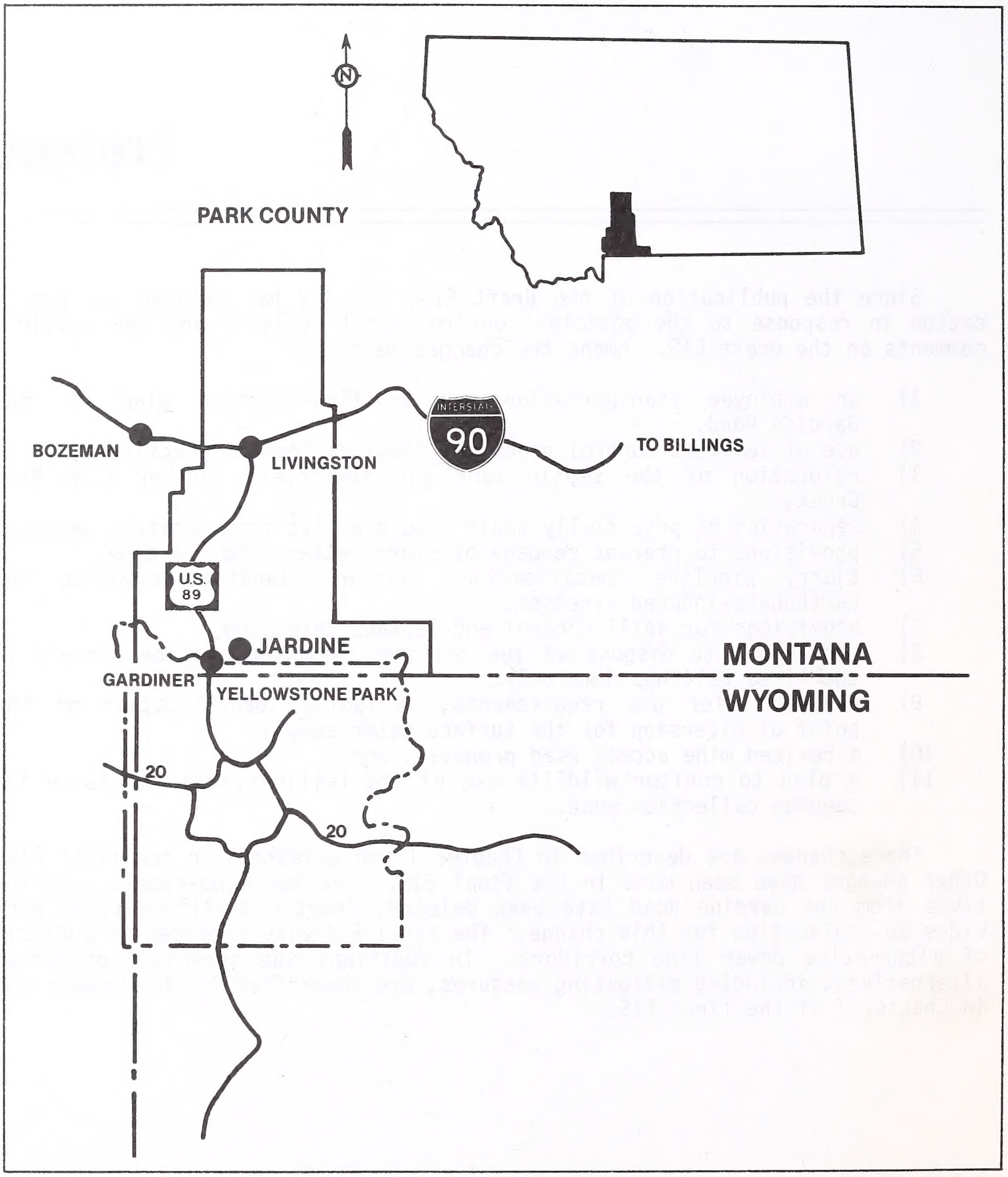

Figure S-1: The applicant proposes to mine for gold at Jardine, Montana, located 3 air miles north of Yellowstone National Park.

Summary

The Homestake Mining Company and the American Copper and Nickel Company have filed joint venture plans with the Montana Department of State Lands (DSL) and the U.S. Forest Service to build a new mill and underground gold mine, known as the Jardine Joint Venture (JJV) Project, on the west side of Mineral Hill above Jardine, Montana (figure S-1). The two regulating agencies must decide whether to approve the permit as applied for, approve the permit with modified mining or reclamation plans, approve the permit subject to stipulations, or deny the permit. (The joint venture proposal is referred to in this EIS as the applicant's proposal.)

THE APPLICANT'S PROPOSAL

During full operation, the mine would extract 1,050 tons of ore per day five days per week. The mill would process the ore into gold concentrate. Next, the concentrate would be refined into gold dore in an electrolytic furnace. The mill waste, or tailings slurry, would be piped to either a sealed tailings dump or back into the mine. About 450 tons of filtered tailings would be discarded 7 days per week in the dump. About 300 tons per day would be used to fill the empty mine cavities. Water would be removed from the slurry and returned to the mill.

In building the project, the applicant would establish an 18-acre facilities complex. Over the next 20 years, miners would drill and blast about seven miles of new underground workings.

The project would employ 150 people; 75 would work in the mine, 25 in the mill, and the rest in administration and maintenance. The applicant expects to hire 120 workers locally.

AREAS OF CONTROVERSY

The Department of State Lands and the U.S. Forest Service identified issues and concerns related to the applicant's project. The two agencies held public meetings on November 14, 1984, December 3, 1985, and March 11, 1986, in order to gather comments on the project from citizens. Areas of controversy include wildlife, air and water quality, socioeconomic impacts, and road and power line corridor alternatives. These and other concerns are discussed in the introduction.

PREFERRED ALTERNATIVES

The agencies' preferred alternatives are the applicant's mining and reclamation proposal plus mitigating measures, and the power line corridor alternative 2. Chapter I describes in detail the mitigating measures of the agencies' preferred alternatives.

The agencies analyzed alternatives to the applicant's project plan. The alternatives included

1) county access roads from Gardiner to the mine,
2) tailings dump sites,
3) mine-access roads, and
4) Power-line corridor alternatives.

Among the alternatives considered, all mine-access road alternatives, three tailings disposal site alternatives, and one county road alternative were eliminated for various reasons. The alternatives that are dismissed are discussed in Chapter I.

SUMMARY OF IMPACTS OF THE PROPOSAL (BY DISCIPLINE)

Geology. The tailings dump would be very stable during the operation of the mine and for centuries to follow. Excessive erosion and gullying could occur in the diversion ditch alongside the tailings dump during a 100-year flood event.

Hydrology. The maximum quantity of water required by the project would be about 3.31 cubic feet per second. This quantity of water would be withdrawn from Bear Creek and would deplete the stream by a factor of 0.5 percent during periods of low flow. This depletion could potentially affect the amount of water available to maintain minimum instream flows depending on the outcome of the present adjudication process.

Soil erosion and sediment loading to Bear Creek are predicted to increase during construction and approach baseline levels by year three. Actual concentrations of total suspended sediment in Bear Creek would depend largely on prevailing weather conditions.

Sewage generated by the project would be treated by a septic-tank drainfield system located 500 feet from Bear Creek. A small increase in the concentration of total nitrogen would be expected in Bear Creek below the drainfield site.

Two historic tailings impoundments would be removed and placed within the proposed tailings dump. This action would result in a decrease in the loading of cyanide, arsenic, and other heavy metals to the ground water system and Bear Creek.

Aquatics. Increases in total suspended sediment (TSS) and total nitrogen in Bear Creek would have little effect on aquatic insect and algal communities. Changes, if any, would be temporary, and recovery would be rapid. Small reductions in streamflow would not significantly reduce habitat for aquatic organisms.

Fisheries. The concentrations of total suspended solids (TSS) and total nitrogen in Bear Creek are predicted to increase as a result of mining activities (see Chapter III--Hydrology). However, these increases would be insignificant and are not expected to adversely affect the fishery. Slight decreases in streamflow would have negligible impacts on trout.

Soils. Biological impacts would occur in soils stored for prolonged periods. These impacts include a reduction or loss of soil microorganisms important to plant growth and nutrient cycling, a breakdown of soil structure, a reduction in organic matter, a loss of soil nutrients, and a loss of native seeds and other potentially active vegetative parts. Until vegetation is established, soil erosion would be moderate on the steep waste rock dump slopes, and minimal in other disturbance areas. Plant toxicity problems due to the chemical characteristics of soils or underlying waste materials are not expected.

Vegetation. Mining would destroy 67 acres of native vegetation and 26 acres of previously disturbed land. The tailings dump, tailings sites from previous mining, and stored topsoil would be revegetated while the mine operates. With few exceptions, seeded grasses and forbs would establish an erosion-controlling ground cover. Douglas-fir would slowly invade the waste rock dumps, road and slurry line corridors, and edges of the tailings dumps. Planted Douglas-fir seedlings would also grow on the waste rock dumps. Several decades would be required for newly established Douglas-fir to reach premining heights. Problems that may be encountered during revegetation include introduction of weeds, occasional erosion on steep slopes, and damage to developing plants by wildlife and blowing tailings.

Wildlife. Along with previously developed land, mining would remove 67 acres of wildlife habitat. Displaced wildlife would find adequate habitat nearby and reclaimed land would eventually provide suitable habitat. Elk and deer would initially avoid mining activity, but may, after habituation, move to habitats near the permit area. Significant disruptions of elk migrations are not expected. Mine-related traffic may increase road kills and conflict with other vehicles during the late-season elk hunt. Increases in poaching and antler-collecting, combined with existing levels of these activities, would be detrimental to wintering big game animals. Proposed logging would only slightly increase negative impacts on elk.

Threatened and Endangered Species. Mining would remove 67 acres of spring habitat used by foraging grizzly bears. The grizzlies would respond to habitat loss by moving into nearby, suitable habitats. After mine closure, revegetated lands would supply adequate foraging areas. Human activity would initially displace grizzlies from the vicinity of the permit area; however, some grizzlies would become accustomed to human activity and may forage near the mine, increasing the chances for encounters between grizzlies and humans. Human/grizzly conflict could lead to management actions that may include relocation or destruction of some grizzlies. The number of conflicts and outcomes of management actions cannot be predicted.

Population growth (with or without the mine) would increase recreational use of the area, which would in turn increase conflicts between grizzlies and humans. Opportunities to poach grizzlies and bald eagles would increase as the human population rises. Logging could increase impacts on grizzlies; however, the Gallatin National Forest would manage logging to minimize the increase.

Air Quality. With proper control, the predicted dust emissions would not adversely affect the air quality near Jardine. The estimated total suspended particulate (TSP) concentrations occurring during the operation would probably be well below all applicable Montana Ambient Air Quality Standards (MAAQS).

Income. Mine employment would add $3.4 million annually to Park County income once the mine is at full employment. Secondary job increases would add between $359,936 and $506,160 to total county income.

Employment. The project would add 140 new jobs to the Park County economy. An additional 32 to 45 jobs would be created due to increased income and spending from new mining jobs.

After permanent closure of the mine, employment would decline to what it would have been without the mine. Temporary closures may cause service sector businesses to lay off other employees, if the closure lasts long enough.

In the cumulative scenario, logging would add about five seasonal jobs from 1987 to 1996. These positions may be filled by Park County residents.

Sociology. Demography--The proposed project is expected to employ about 50 workers during the initial construction period and first phase of the mine operation (1986 and 1987). Beginning in 1988, the mine is scheduled for full-time operation and, at that point, the mine and mill would employ about 150 people. Given the added need for services and the available income due to the mine and mill, secondary employment in the county would increase by about 45 persons by 1991.

Social Life--Residents in the Gardiner area vary both in their perceptions of how the project may affect the area and in the importance they ascribe to these changes. Some residents of the Gardiner area may consider the quality of their lives diminished because of changes that could result from mining activity or from the increased population accompanying the project. The increased population; additional traffic, especially during construction; increased noise at the minesite from mine/mill construction and operation; impacts to the physical environment; and potential social conflict could cause people to perceive changes in the characteristics of the area they value most. Residents may perceive a deterioration in the quality of the natural environment; a faster pace of life; less friendliness among residents; or a reduction in the quiet, solitude, and privacy presently enjoyed in the area. Some residents may perceive project employment and income as an asset to the local economy.

Community Services--Impacts to community services that would occur because of the proposed mining project are associated with increased migration into the area. Workers and their families would move in, establish residences, and exert an increased demand on community services. Predicting the impact of this increased demand, however, depends on knowing the exact numbers of newcomers and where they would settle.

Fiscal. The JJV project would increase tax revenues for Park County, both school districts in Gardiner, special service districts in Gardiner, and the state of Montana. Over the life of the project, and at current gold prices ($316.47 per ounce), the applicant would add between $986,000 and $2.6 million to the annual tax base of the Park County and both Gardiner school districts. The service districts in Gardiner would receive between $634 and $4,320 in increased revenues at current rates for services, assuming that incoming workers build 15 new homes within the service district boundaries. The state would receive $301,570 annually from the mine at current gold prices.

Land Use. Land use would not change substantially in Park County due to the project. Reclamation of surface disturbance within the permit area would be planned so as to establish suitable wildlife habitat and livestock grazing land after mine closure (see Chapter III--Vegetation). Within Park County, up to 19 acres of agricultural land could be converted to residential uses if incoming mine workers chose to construct new homes.

Transportation. The project would cause increases in traffic and accidents on FAP 78 and the Jardine Road. Traffic increases on FAP 78 would be moderate. Impacts to the Jardine Road would be variable. The JJV plan to reduce traffic would cause an increase of up to 84 vehicle trips per day on the county road. Such an increase would be minor compared to times when the road experiences heavy recreational use. Mine traffic would be highly visible during periods when the road is being used primarily by local area residents. However, mine traffic would be scheduled to avoid peak use of the road by local area residents driving to and from work and by school buses.

Cumulative impacts on the Jardine Road and U.S. 89 due to proposed timber sales would be negligible. Two sales are planned for 1989 to 1994. The first sale would generate six additional vehicles per day on each road and the second would add about four vehicles per day.

Recreation. The project would have little direct impact on recreation on National Forest land.

Cultural Resources. The project would cause up to 16 structures in the proposed Jardine Historical District to be removed. The loss of structures in addition to construction of new facilities would alter the appearance of the historic mining area.

Aesthetics. Although the Jardine area has been disturbed by previous mining, the applicant's project would be highly visible to local residents and visitors traveling to Jardine and upstream Bear Creek. The milling building, crushing facilities, and tailings dump would be the most evident features.

Due to surrounding hills, the operation would only be visible from within 1.2 miles when approaching Jardine on the county road. The operation would also be visible in the background from some areas of Yellowstone Park--Mammoth terraces and Yellowstone lodge, for example.

After mining is complete, all structures would be removed and all disturbed areas revegetated. The tailings impoundment would probably still be recognizable as differing from the surrounding landscape.

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CHAPTER IV

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Introduction

The Homestake Mining Company and the American Copper and Nickel Company (referred to here jointly as "the applicant") plan to build a new mill and underground gold mine, known as the Jardine Joint Venture project, on the west side of Mineral Hill above Jardine, Montana (figure IN-1). The Montana Department of State Lands (DSL) and the U.S. Forest Service (Forest Service) have determined that the project may significantly affect the quality of the human environment. As a result, the two agencies are required to prepare an environmental impact statement (Montana Environmental Policy Act [MEPA], 1971, and National Environmental Policy Act [NEPA], 1969).

The National and Montana Environmental Policy Acts require the Forest Service and DSL to follow a detailed procedure that includes

--issuing a draft EIS,
--encouraging and accepting public comments on the draft, and
--issuing a final EIS. In accordance with rules adopted by DSL and the Environmental Quality Council regulations, the final EIS may--

(a) modify alternatives, including the proposed action,
(b) develop and evaluate alternatives not previously given serious consideration,
(c) supplement, improve, or modify the analysis contained in the draft,
(d) make factual corrections,
(e) respond to or explain why comments do not warrant further response.

The EIS analyzes (1) the applicant's proposal and alternatives, (2) the lands, people, and resources the proposal would affect, and (3) the consequences (or impacts) of the proposal and alternatives. The EIS also presents the alternatives the agencies prefer. The Forest Service will issue its proposed decision in a decision notice along with the final EIS. DSL can make a decision no sooner than 15 days following publication.

Issues and Concerns

DSL and the Forest Service received comments at public meetings in Gardiner on November 14, 1984 and December 3, 1985. Concerns expressed at the first public meeting and in response to the agencies' information brochure are summarized here. Comments presented at the public hearing held on December 3 can be found in Chapter IX.

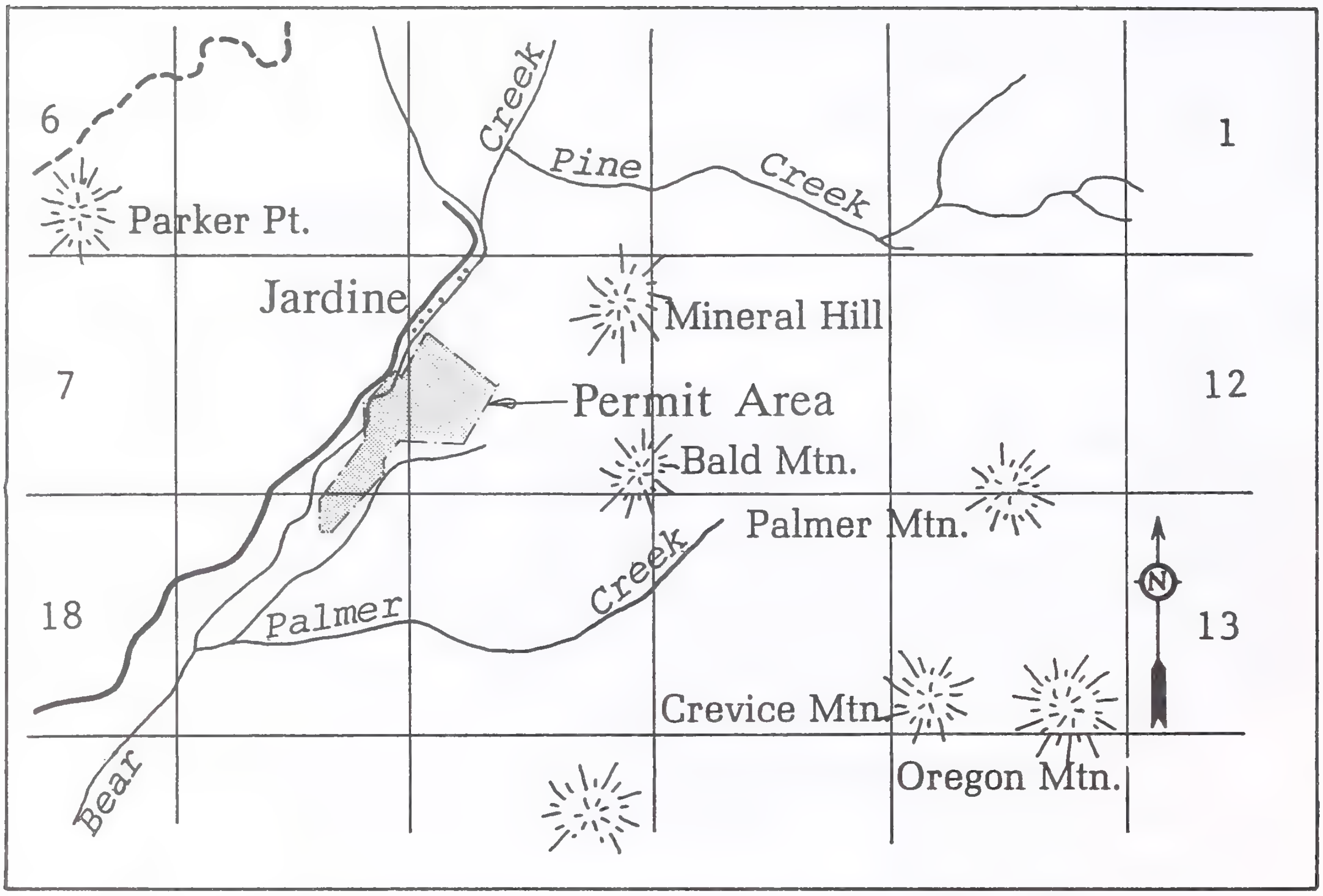

Figure In-1: Mining would occur on Mineral Hill, above Jardine.

Public concerns regarding the Jardine Joint Venture (JJV) Project include the following:

1) Noise level at Jardine: Construction; mine/mill operation; traffic.

2) Visual aesthetics: In Jardine, especially tailings and possible temporary housing; in Gardiner, temporary housing.

3) Wildlife: Potential increase in poaching; effect of hunter access to mining property or on mining roads; elk migration and winter range (reduction due to land trade); threat to grizzly bear habitat.

4) Air quality: Tailings dust; dust from non-tailings disturbed areas; dust from increased road traffic; increased woodburning for residential heat; effect of mill operation on air quality of nearby wilderness; need to comply with air quality standards for Class I areas.

5) Tailings: Location near Bear Creek potential for polluting the creek; need for lining the mine return slurry pipeline trench and tailings discharge pipeline trench; need to isolate storage of tailings from ground water in the mine; need to adjust tailings disposal system to weather; effect on area soils; size of tailings site.

6) Surface dumps and waste rock: Surface ground water discharge; chemical nature of dumps; location of dumps; reclamation of dumps.

7) Toxic materials: Need to isolate from the work force and the environment.

8) Reclamation: Responsibilities after plant closure; need for continuous reclamation.

9) Water quality: Need for Montana Department of Health and Environmental Sciences surface water discharge permit; deterioration from rural housing development; deterioration of Bear Creek and Yellowstone River, specifically from tailings; potential for tailings spill.

10) Water rights: Mining company claim on Bear Creek questionable; impact to other users by reviving rights; effect of National Park Service water rights to Bear Creek.

11) Watershed: Threat to the Jardine-area watershed.

12) Transportation: Location of new road, if any; request for speed limit of 15 mph; increased traffic, especially on Jardine Road; potential for accidents, especially involving school children; need to improve Z Hill.

13) Population: Potential for secondary population response; potential for larger population increase in the Gardiner area if assumptions regarding commuting and local hire are not accurate.

14) Social values: Potential conflict between newcomers and current residents; potential union/non-union conflict.

15) Social structure: Addition of another separate social group to the Gardiner area; income disparity between mine workers and other Gardiner area residents.

16) Housing: Demand greater than supply in the Gardiner area; demand increase as workers choose not to commute.

17) Community services: Potential for reducing the quality of education in Gardiner schools; adequacy of community services in the Gardiner area, specifically law enforcement, sewer treatment, water supply and fire protection.

18) Employment: Assumption questionable of 80 percent local hire; secondary employment response.

19) Economic: Impact of reduced water quality, fisheries, and wildlife on area businesses; potential for decreased housing values in Jardine if water quality or aesthetics deteriorate; early or temporary plant closure effect on business and housing investment.

20) Cultural Resources: Fate of historic houses at Jardine.

21) Utilities: Need for new power line or corridor from Gardiner to Jardine, its possible location, and its effect on raptors.

22) Construction phase: Length of construction; party responsible for building the mill.

23) Possible connection between Jardine Joint Venture and outfitters (more competition for local outfitters).

24) Need to consider impacts in combination with other developments, specifically logging and West Gardiner access.

25) Potential for unmitigatable impact in arsenic-related process.

26) Greater Yellowstone Ecosystem: Threat to natural vegetation, wildlife, air, and water quality of Yellowstone National Park and National Forest lands; cumulative effect on ecosystem from gold mining, oil drilling, geothermal development, and Ski Yellowstone.

The benefits anticipated from the applicant's proposed project include:

1) year-round employment for local residents,
2) an increased tax base for Park County,
3) a more stable economy in the Gardiner area,
4) potential for reduction in social welfare needs in the Gardiner area.

PREVIOUS RESEARCH

Sources of Information

This EIS used many sources of information. The sources are listed under References Cited at the end of this publication. The key documents are described here in more detail.

The applicant submitted a detailed "plan of operations"--or application--for a mining permit to conduct the Jardine Joint Venture project. This document is the most important source used in compiling the draft EIS. Included in the application is an extensive compilation of baseline information for 16 separate disciplines. For those interested, the application is available for review at the Department of State Lands, Helena, the U.S. Forest Service offices in Bozeman, and at Park County's planning offices in Livingston.

The applicant hired Western Technology and Engineering, Inc. (Westech), of Helena, to conduct research studies into the specific disciplines that the proposed project would potentially affect. Much of the information in this draft EIS comes from Westech's reports, and the reports of its subcontractors.

A detailed report on the Jardine tailings disposal facility was prepared for the applicant by Steffen Robertson and Kirsten of Lakewood, Colorado.

Mountain International, Inc., of Helena, prepared the socioeconomic report for the Jardine project. This report covers topics such as employment, housing, and traffic conditions in the project area. It conforms to the Hard Rock Mitigation Impact Act (HB718 as amended), which requires developers to pay net increased operating and capital costs for local government due to hard rock mineral development.

METHODS AND STUDY AREAS

This brief description of the methods used in this EIS by the disciplines may help in understanding some of the topics discussed.

Geology

Two general study areas were used; one covers the greater Gardiner/Jardine area and is based on the U.S. Geological Survey report and map titled "Geology of the Gardiner Area, Park County, Montana." The other study area focuses on the mine/mill area at Jardine. The applicant provided detailed geologic maps and studies for the proposed tailings disposal and underground mine areas.

Hydrology

The surface water study includes analyses of water availability and water quality that focus on the main stem of Bear Creek between Pine Creek and the confluence with the Yellowstone River. Included is a discussion regarding the potential impact to the Yellowstone River. The ground water study evaluates the occurrence and movement of water in the alluvial aquifer in the vicinity of the existing and proposed tailings dump areas near the town of Jardine. The cumulative study area is limited to the Bear Creek drainage.

Soils

The applicant conducted a detailed (Order I) soil survey on about 2,500 acres in and around the town of Jardine. This area includes the 410-acre proposed permit area and the 93-acre proposed disturbance area.

Sociology

The social sciences study area included all of Park County with a more detailed emphasis on the Gardiner-Jardine area. Mammoth, Wyoming, and Livingston, Montana, were also included in the analyses for some social science topics. The areas north of Livingston in Park County were not studied due to the improbability of mine workers locating there.

The study methods used included a survey, interviews, literature review, analysis of relevant reports, and census and fiscal data. Consultants to the applicant used two computer models (WEDM and PUFMOD) to provide forecasts for local government expenditures, and county employment, income, and population.

Cultural Resources

During 1981 and 1982, an intensive cultural resource survey of about 3,100 acres was conducted (Steere, et al., 1982) in the Jardine area. The cultural resources on the project area were then reevaluated by Historical Research Associates (HRA). HRA prepared an impact assessment and management recommendations for all sites eligible for listing on the National Register of Historic Places (project application, 1984).

Vegetation

The vegetation study area includes and surrounds the proposed permit area. It is bound on the east by Mineral Hill and on the west by Parker Point. The southern part of the study area reaches almost to the lower limit of section 17; the northern part roughly follows Bear Creek to the township division.

Wildlife

The proposed permit area is centered within the Jardine wildlife study area (figure II-10). The study area extends from the northern boundary of Yellowstone National Park, east to Crevice Creek, west to Little Trail Creek, and north to Monitor Peak. Along with the study area, a cumulative impacts analysis area was developed. This cumulative area included additional habitats that could be visited by elk or mule deer from the Jardine area. Therefore, the cumulative area was delineated by year-round elk and mule deer ranges found outside of Yellowstone National Park (figures II-11 and II-13).

Threatened and Endangered Species

The proposed permit area is within the threatened and endangered species assessment area (figure II-16). The assessment area makes up the south-central portion of the Hellroaring/Bear (Creek) Bear Management Unit and includes Bear, Eagle, and Little Trail creeks.

In addition to the applicant's proposal, the Forest Service has scheduled timber sales in the assessment area. Cumulative impacts of mining and logging are discussed in Chapter III--Threatened and Endangered Species.

Analyses were based on a biological evaluation that describes the ecology of threatened and endangered species in the project area and determines effects of the mine and other proposed projects. The evaluation was prepared by the U.S. Forest Service and was reviewed by the U.S. Fish and Wildlife Service in accordance with Section 7 of the Federal Endangered Species Act of 1973.

OTHER ACTIVITIES IN THE PROJECT AREA

Logging

The U.S. Forest Service (USFS) is selling timber in the Palmer Co-op sale area which is now being cut. Two hundred and thirty acres of the 400-acre sale area will be logged. Logging began in July 1984 and is scheduled to end September 30, 1986. The sale area is on Sections 14, 15, 22, and 23 of T9S, R9E near Palmer and Crevice Mountains, east of Gardiner. Four irregular units will be clearcut. Total harvest will be 140 acres per year. During the two years of logging, 1.5 miles of new roads will be built; 1,600 logging truck trips and 3,000 pickup truck trips will be added to the traffic on the Jardine Road.

After logging, slash will be piled by machine. The logged areas will revegetate naturally. Gates will be built on all new roads, with cooperative road management with private landowners.

The Gallatin National Forest Draft Forest Plan (1985) included two timber sales--the Pine Creek and Parker-Eagle--which were deleted after publication. The new 10-year plan (through 1996) entails a cutting unit of about 25 acres per year, east and north of Gardiner, and near Pine Creek, east of Jardine. Exact locations have not been specified (Larry N. Lewis, pers. comm., District Ranger, Gallatin National Forest, September 16, 1985). After logging, slash would be piled by machine. The logged areas would revegetate naturally. Gates would be added to new roads or they would be closed permanently.

West Gardiner Access

The USFS is proceeding with an in-depth analysis to determine access requirements for National Forest Service lands west of Gardiner, just north of Yellowstone Park. The 40,000 acres cover eight drainages. County roads access the lower reaches of these drainages. In three drainages (Divide Creek, Trail-Sunlight Creek, and Sphinx Creek) there is access to national forest lands. In the other five drainages (Aldridge, Mol Heron, Upper Cinnabar Basin, Horse Creek, and Skull Creek), a narrow band of private land lies between the county road system and national forest lands. In the Draft Environmental Assessment of the West Gardiner Access Program, the USFS recommended that access be acquired into each of the units. Its preferred alternative would allow "...seasonal public use and year-long administrative use in each unit. Public use restrictions will be established based on a cumulative effects analysis for grizzly bear management." Final decisions and implementation are expected to be complete by the end of 1985.

AGENCY RESPONSIBILITIES

A number of agencies have or could have jurisdiction over the Jardine Project.

Montana Department of State Lands (DSL)

DSL administers the 1971 Montana Metal Mine Reclamation Act (also called the Hard Rock Mining Act), with which the applicant must comply. The purposes of the act are, first, to recognize and protect the usefulness, productivity and scenic values of the lands and waters within the state, and second, to reclaim to beneficial use the lands used for metal mines. The act and its regulations (ARM 26.4.101 et seq.) set forth the steps that must be taken in the issuance of an operating permit for, and the reclamation of, the proposed mine and mill. The act applies to all lands within Montana. Thus, DSL will regulate mining activity on both federal and private lands.

U.S. Forest Service

The Forest Service (USFS) has authority to permit and regulate all operations and uses of national forest system lands.

The 1872 General Mining Law, as amended by the Multiple Surface Use Act (P.L. 167) of July 23, 1955, allows any prospector who discovers a valuable mineral deposit on national forest system lands open to mineral entry to locate and work on a mining claim. (See also 36 CFR 228.) At the same time, the Organic Administration Act of 1897 authorizes the Secretary of Agriculture to regulate occupancy and use of the national forests for the protection and management of national forest resources--this pertains to all national forest users, including prospectors and miners.

The USFS management policy for mining activity originates from the Mining and Mineral Policy Act of 1970, the National Materials and Minerals Policy, Research, and Development Act of 1980, and a number of executive (presidential) orders.

The "Locatable Mineral Regulations" (36 CFR 228) require a plan of operations to be submitted to the USFS for approval. Review and approval of the engineering report, and plans and specifications for the tailings dam are subject to USFS requirements.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service administers the Endangered Species Act, as reauthorized in 1982, and the Bald Eagle Protection Act of 1940 (as amended). Federal agencies (in this case, the U.S. Forest Service) involved in actions potentially affecting threatened or endangered species must prepare a biological assessment to comply with the Endangered Species Act. If the assessment determined that impacts would adversely affect threatened and endangered species, the preparing agency would consult with the Fish and Wildlife Service to design measures to protect the affected species. A biological evaluation on grizzly bear, bald eagles, gray wolves, and peregrine falcons was prepared by the USFS and reviewed by the U.S. Fish and Wildlife Service. The Fish and Wildlife Service then offered an official opinion on the impacts of the project.

State Historic Preservation Office

The State Historic Preservation Office has the responsibility to cooperate with and advise DSL when potentially significant historical, archaeological, or other cultural resources are located in a project area (Montana Antiquities Act [MCA 22-3-401 through 22-3-441], and the National Historic Preservation Act [P.L. 89-665 as amended and reauthorized E.O. 11593]). Part of the advice given to DSL may include comments on a company's plan for impact mitigation of sites eligible for nomination to the National Register of Historic Places. The office also reviews the EIS to ensure compliance with cultural resource regulations.

Under the Montana Antiquities Act, the State Historic Preservation Office is responsible for issuing antiquities permits for projects on state-owned lands. Under the National Historic Preservation Act, the office provides federal agencies with site value recommendations for cultural resources that are eligible for listing on the National Register for Historic Places. During mine operation, DSL monitors compliance with historic preservation and monitoring plans.

Montana Department of Health and Environmental Sciences (DHES)

Air Quality Bureau. The Air Quality Bureau of DHES administers the Montana Clean Air Act. Any proposed project that has the potential to emit more than 25 tons per year of any pollutant must obtain an air quality permit before beginning construction. The applicant must apply Best Available Control Technology (BACT) to each emission source. The applicant must also demonstrate that the project will not violate Montana or Federal Ambient Air Quality Standards.

Water Quality Bureau. The Water Quality Bureau of DHES is responsible for administration of the Montana Water Quality Act. This state law provides a framework for the classification of surface water. It also establishes surface water quality standards as well as permit programs to control the discharge of pollutants into state waters.

A Montana Pollutant Discharge Elimination System (MPDES) permit must be obtained before any discharge to surface water can occur. The MPDES permit contains water quality limitations and requires self-monitoring of effluent by the permittee. Mining operations must also comply with Montana ground water standards.

The tailings impoundment must be constructed and operated to prevent water discharge, seepage, drainage, infiltration, or flow that may pollute surface or ground waters. Complete plans and specifications for tailings ponds must be submitted to DHES no less than 180 days before initial construction.

Montana Department of Natural Resources and Conservation (DNRC)

DNRC administers two acts that are applicable to mining development in Montana. These are the Montana Major Facility Siting Act (MFSA) and the Montana Water Use Act. The MFSA requires state approval before construction of any electrical transmission line that exceeds 69 kilovolts (kV) or 10 miles in length. A water rights permit is required by the Montana Water Use Act for any surface water diversion or ground water withdrawal exceeding 100 gallons per minute.

Hard Rock Mining Impact Board

The Hard Rock Mining Impact Board (Hard Rock Board), created by the passage of House Bill 718 in 1980, is attached to the Montana Department of Commerce for administrative purposes. It is a quasi-judicial board intended to act as "referee" in hearing disputes between local government units and large-scale mineral developers over the impact mitigation plan prepared by the developer. In the impact mitigation plan, the developer identifies the increased public-sector costs associated with major mineral development and commits to pay, according to a specified time schedule, all increased capital and net operating cost to local government units that will be a result of the development.

The review of the impact plan by the Hard Rock Board is intended to occur concurrently with the procedure for fulfilling the operating permit requirements. If disagreement occurs between Park County or any affected unit of local government and the proponent, the disagreeing party can file an objection with the Hard-Rock Board.

An operating permit issued by DSL for a large-scale mineral development would be conditioned to provide that mining may not begin until the Hard Rock Board approves the impact plan and until the permittee has provided a written guarantee to DSL and to the Hard-Rock Board of compliance within the time schedule with the commitment made in the impact plan approved by the Hard Rock Board. If the permittee does not comply with that commitment within the time scheduled, DSL, upon receipt of written notice from the Hard Rock Board, will suspend the permit until it receives written notice from the Hard Rock Board that the permittee is in compliance.

Army Corps of Engineers

The Corps of Engineers would require a 404 permit if any bridges are replaced or strengthened in a manner that would put fill in any river. Need for a 404 permit is not anticipated at this time.

Local Conservation District

Similarly, bridge construction plans would require approval by the local conservation district if the company were planning to alter streambanks.

ADMINISTRATIVE PROCESS

After evaluation of this EIS, both DSL and the Forest Service have a number of options.

Montana Department of State Lands

DSL must take one of four administrative actions: (1) approve the permit as proposed, (2) deny the permit, (3) approve the permit with modified mining or reclamation plans, and (4) approve the permit subject to stipulations.

1. Approve the permit as proposed

If DSL finds the applicant's proposal environmentally acceptable and requires no changes, it could approve the plans as proposed with no changes.

2. Deny the permit

DSL may deny the permit if the mining or reclamation plans violate the laws administered by DSL or the water and air quality laws administered by the Department of Health and Environmental Sciences.

3. Approve the permit with modified mining or reclamation plans

If the proposed plan were unacceptable, DSL could return it with a request that the applicant submit a modified plan. If, for example, DSL selected an alternative different from the applicant's proposal, DSL would require the applicant to submit new project plans.

4. Approve the permit subject to stipulations

If parts of the proposed plan were considered unacceptable, DSL could grant the permit with stipulations. Possible stipulations would include any modifications or additions to the proposed plans that the Commissioner considered necessary to meet the requirements of state laws. Stipulations (or mitigating measures) are listed in Chapter III for most impact discussions.

U.S. Forest Service

Four administrative actions, some of which differ from those available to DSL, would be considered by the U.S. Forest Service: (1) no action, (2) approve the plan of operations as submitted, (3) approve a revised plan of operations with changes incorporated, and (4) approve parts of the plan that are acceptable; defer decisions on other portions of the plan.

1. No action

Under this action, the proposed plan of operations would be denied and, theoretically, no mining could take place; however, this alternative is not valid because under the 1872 mining law the national forest lands on which the project would occur are open to mineral location and entry. Consequently, the Forest Service cannot take "no action" if the applicant meets legal and policy requirements and takes reasonable measures to protect surface resources and public safety.

2. Approve the plan of operations as submitted

If the Forest Service agrees that the plan of operations is complete and adequate as submitted and no changes are required, the Forest Service would approve it.

3. Approve a revised plan of operations with changes incorporated

If the plan of operations as proposed is considered generally acceptable but in need of some revisions, the Forest Service could require changes. These changes would be for management and protection of the surface resources of national forest system lands or public safety.

This administrative action would be selected if the Forest Service chose to require an alternative different from the applicant's proposal or to require any of the mitigating measures recommended in the EIS. If the Forest Service does select an alternative different from the applicant's proposal, the applicant would be required to submit modified mining plans.

4. Approve parts of the plan of operations

The Forest Service could approve part of the plan of operations and defer decisions on other parts of the proposal until further design data or specific information is available. The Forest Service would take action on these aspects of the proposal based on the degree to which they meet the objectives of reasonable environmental protection.

Chapter I: The Project and Alternatives

JARDINE JOINT VENTURE'S PROPOSAL

The Jardine Joint Venture Project is located near Jardine, Park County, Montana (figures S-1 and IN-1). The project is in the Bear Creek drainage, a tributary to the Yellowstone River, on the southeast flank of the Absaroka Mountain range. Jardine and the mine are located about five miles northeast of Gardiner, Montana, and 52 road miles south of Livingston, Montana.

According to the Jardine Joint Venture (JJV) application, mine construction could begin in 1986. The mine could be fully operational in mid-1988. Yielding an average of 1,050 tons of ore per day, five days per week, the mine has an estimated life of 20 years, through 2008. The mill would process about 750 tons of ore per day, seven days a week. The gold would have concentrated and refined in the mill and electrolytic furnace. Waste material, or tailings from the mill would be deposited in a lined disposal dump within a mile of the mill or backfilled into the mine. The project would last for at least 22 years, including 18 months of construction, 20 years of production, and at least one year of final reclamation.

The project area encompasses 410 acres, of which only 93 acres would be disturbed by construction and operation (table I-1). The permit area would cover parts of the northeast, northwest, and southwest quarters of Section 9 and southeast quarter of Section 8 of T9S, R9E. Most of the disturbance would be on private land owned by the applicant (figure I-1). Only a small area of Forest Service land would be covered by tailings. About 28 percent (26 acres) of the proposed disturbance area has been disturbed already (see Chapter II--Vegetation).

Mining Plan

Mining at the project would be underground. Five levels would be developed into the new mining area at 150-foot vertical intervals in Mineral Hill. Levels would be constructed using rubber-tired diesel equipment. Four of the levels--600, 750, 900, and 1,050--were constructed during earlier mining, and all but the 600 level are caved in at the portals because of rotted and collapsed timbers. These portals would be reopened and stabilized. Only the 450 level would be new. All levels would be extended to new mining zones east and below the Bear Gulch fault.

Table I-1: Surface Area Disturbance

Facilities	Acres
Waste dumps at portals and surface water control structures	7.7
Soil stockpiles	4.0
Mill and mine facilities, parking lots (including disturbance at 1,050 level)	12.0
Tailings disposal site and support facilities	53.0
Roads	7.3
Slurry lines	3.0
Gravel pit and waste plant	1.1
Old tailings (outside new tailings deposition)	2.5
Partially reclaimed old tailings near Bear Creek	2.2
Air shaft and access	0.1
Total disturbance area	92.9
Undisturbed permit area	317.1
Total permit area	410.0

Source: Jardine Joint Venture Project Application, 1984.

The primary method of mining would probably be cut-and-fill breast stoping, using mill tailings waste to backfill the mine. Vertical crater retreat mining methods may also be used in portions of the mine where conditions warrant. Cut-and-fill breast stoping, vertical crater retreat mining, or a combination of these may be used to mine the ore body.

In cut-and-fill breast stoping, mill tailings would be backfilled into the mine as a slurry to fill the stopes as mining progressed upwards. In the mine, cement would be added to the slurry to form a solid platform on which the miners would stand while drilling and blasting ore from the stope ceiling, one layer at a time. The tailings backfill would stabilize the walls and prevent spalling rock from diluting the mined ore--the major advantage of the cut-and-fill stoping method of mining.

As fill material is added to the stopes, the ore-withdrawal chutes would be extended upward using timbers. Ore from the chutes would be removed at the 1,500 level by diesel-powered muckers--low-profile, rubber-tired, front-end loaders (Mike McClean, American Copper and Nickel Company, pers. comm., February 26, 1986).

When miners set the last charges in each stope, they would be standing on about 150 feet of consolidated sand fill. The ceiling of the sand-filled stope would be the floor of the mine tunnel above. Each stope set would measure up to 200 feet long, 150 feet high, and average 10-20 feet wide.

The underground workings would not be visible outside the mine. Only five tunnel portals (including the 1,050 level now used for exploration) would reach the surface. These tunnels would provide access and air ventilation.

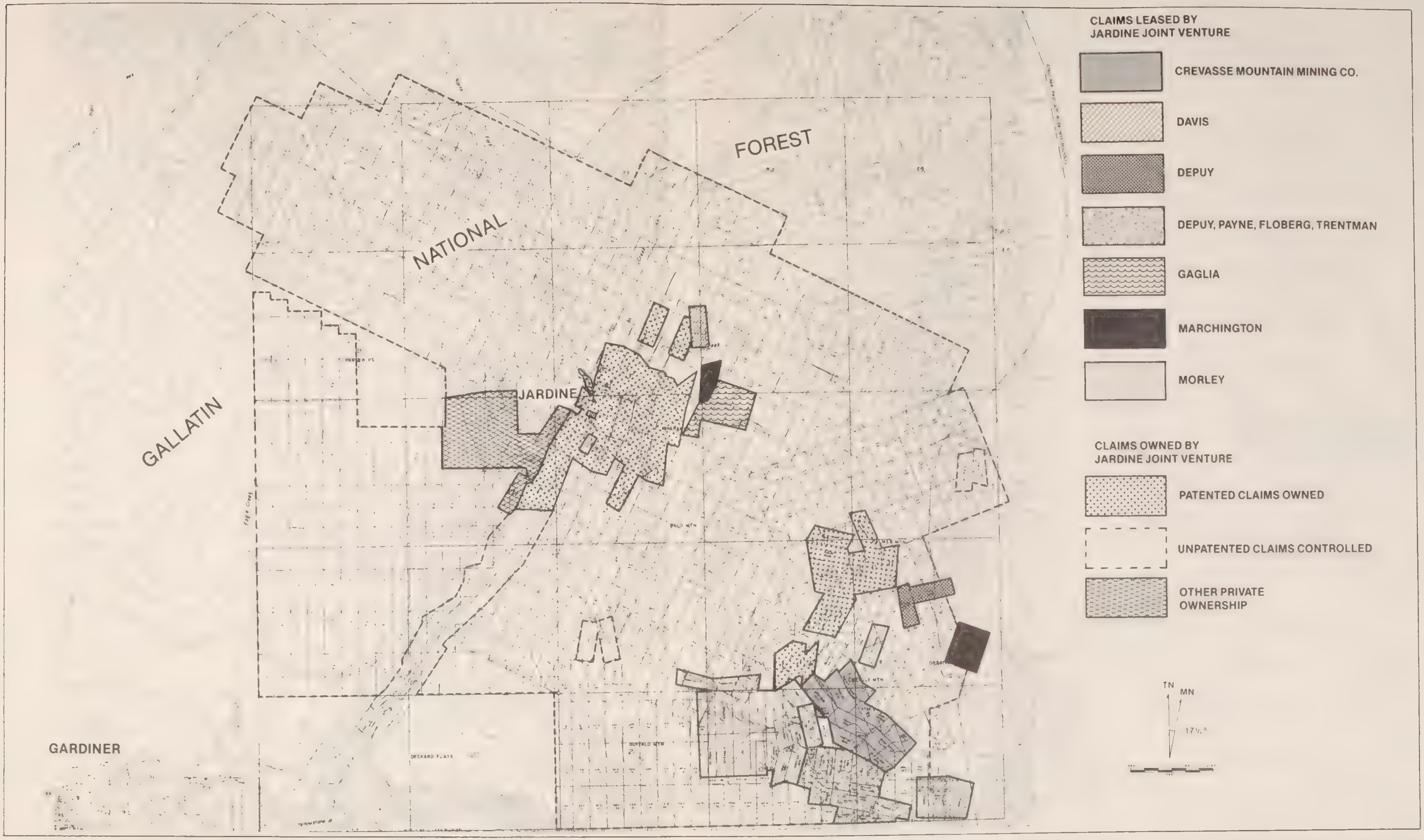
CLAIMS LEASED BY JARDINE JOINT VENTURE
CREVASSE MOUNTAIN MINING CO.
DAVIS
DEPUY
DEPUY, PAYNE, FLOBERG, TRENTMAN
GAGLIA
MARCHINGTON
MORLEY
CLAIMS OWNED BY JARDINE JOINT VENTURE
PATENTED CLAIMS OWNED
UNPATENTED CLAIMS CONTROLLED
OTHER PRIVATE OWNERSHIP
GALLATIN
NATIONAL
FOREST
JARDINE
GARDINER
DECKARD FLATS
BUFFALO MTN
TN
MN
17½°

Figure I-1: The applicant owns or leases the claims detailed in this land ownership map

Internally, numerous cribbed (wooden) service raises would be constructed between levels to provide access for workers and machinery to the active stope faces. Ore would be dropped down cribbed ore chutes to the 1,050 main service level.

The project would produce about 50 to 100 tons of waste rock each day. Most of the waste rock would be stored underground in raises and in stopes, minimizing the need for large storage areas at the surface (Olin Hart, Homestake Mining Company geologist, pers. comm., April 1985). Waste rock that could not be placed underground would be hauled to the surface for disposal in waste rock dumps (Mike McClean, American Copper and Nickel Company, pers. comm., February 26, 1986).

If water were encountered in the mine, the following actions would be taken:

a. Water encountered by drill holes would be contained by grouting the holes with quick-setting cement.

b. Water encountered in mine openings could be the result of 1) tapping the water table, 2) tapping a fault that contains water derived from the surface, or 3) tapping perched water tables. In the case of 1) and 2) above, depending on the volume of water leaking into the mine opening, the area of leakage would be curtain grouted to seal off the water table. In the case of 3), the water would run for a few hours and dry up. If it did not dry up, the grouting procedure could be used.

c. Sandfill slurry pumped into the mine would drain water to underground ditches and sumps. This water would then be recycled for drilling purposes or dust control, or returned to the mill. Sumps would be lined to prevent seepage. Normally, sludge would collect over the liner to form a permanent seal. The same would apply to the ditches. Because the mine openings would be sealed with grouting, backfill and drilling water would be sealed off from the ground water effectively.

The tailings returned to the mine would be made up of the same constituents as the original rock, less 99 percent of the sulfide. Without the sulphur to create sulphuric acid, the potential for acid mine water would be further reduced.

Additional ore may also exist in the Jardine district. The Crevice Mountain area produced gold and arsenic ore that was processed at the Jardine mills; the applicant owns or leases the mineral claims in the Crevice Mountain areas (see figure I-1). Redevelopment of the Crevice Mountain area or the additional ore reserves below the 1,050 level in Mineral Hill would require subsequent approvals by the regulating agencies.

Ore Processing

The mill facilities would be as near as possible to the 1,050 level (see figure I-2). The mill building would be about 200 feet long, 200 feet wide, and 60 feet high. Associated with the 18-acre mill site would be a maintenance shop, warehouse, laboratory, storage yard, parking lot, office buildings, change house, crusher, and ore storage bins. The mill would consist of a crusher, concentrator, leaching circuit, refinery and other equipment.

The milling process would occur in two stages. The first stage (flotation process) would begin with the crushing and grinding of the ore to expose the gold-bearing sulfide minerals. Water would be added to form a slurry of 36 percent solids. This slurry would be subjected to froth flotation--a physio-chemical method of separating and concentrating the metals from finely ground ores. The slurry would be agitated, injected with air, and treated with a frothing agent. Other chemicals (collectors) added to the slurry would cause sulfides and precious metals to attach to rising air bubbles. A foamy froth containing metals would be skimmed from the surface of the slurry. The mill will contain a series of jigs over which the mill feed will be passed prior to sulfide flotation to capture any free gold that may exist in the ore.

The remaining ground rock (flotation tailings) would remain submerged and would leave the mill in slurry form. The flotation tailings would be piped back into the mine or to the tailings disposal site. In the second stage of milling, the froth concentrate would be filtered and leached with cyanide solutions to dissolve the gold. The gold would be precipitated from solution by the addition of zinc dust and collected on drum filters.

The filtercake containing the gold zinc precipitate would be refined in an electrolytic furnace forming a gold/zinc bullion dore. Tailings associated with the cyanide agitation circuit would be piped to the lined tailings disposal dump and the cyanide solution returned to the beginning of the leach circuit. Excess water in the cyanide circuit would be treated with sulfur dioxide gas and lime to remove cyanide in solution. Destruction of cyanide is essential because any cyanide introduced to the flotation process (treated water would be recycled) would cause gold to remain in the solution with the tailings rather than float to the surface with the flotation concentrate. All wastes from the laboratory, change rooms, and mill would be routed to the mill system. Table I-2 is a simple flow chart of the milling process.

Reagents that would be used in the flotation and cyanidation processes are Aerofloat 280, Aero 350 Xanthate, Aerofroth 76, Separan NP10, and sodium cyanide (see appendix 7).

Tailings Disposal

About 60 percent of the tailings slurry would be piped to the tailings disposal dump; the remaining 40 percent would be piped to the 450 level and used as fill in the mine. Slurry water from the saturated tailings that is backfilled into the mine would drain by gravity. The drainage water would be channeled by ditches to lined underground sumps where it would be pumped back into the mill circuit. Mine sumps would be lined with plastic to prevent seepage into cracks and faults. The last two feet of backfill would be mixed with cement to create a hard floor. Slurry and return water pipelines would be constructed using flexible polyurethane or an equivalent pipeline which would resist corrosion and abrasion, and which would withstand stresses during seismic events. Emergency containment ponds would be constructed at the base of the hillside between the mine and the mill, and at the mill facility to contain spills, if they were to occur.

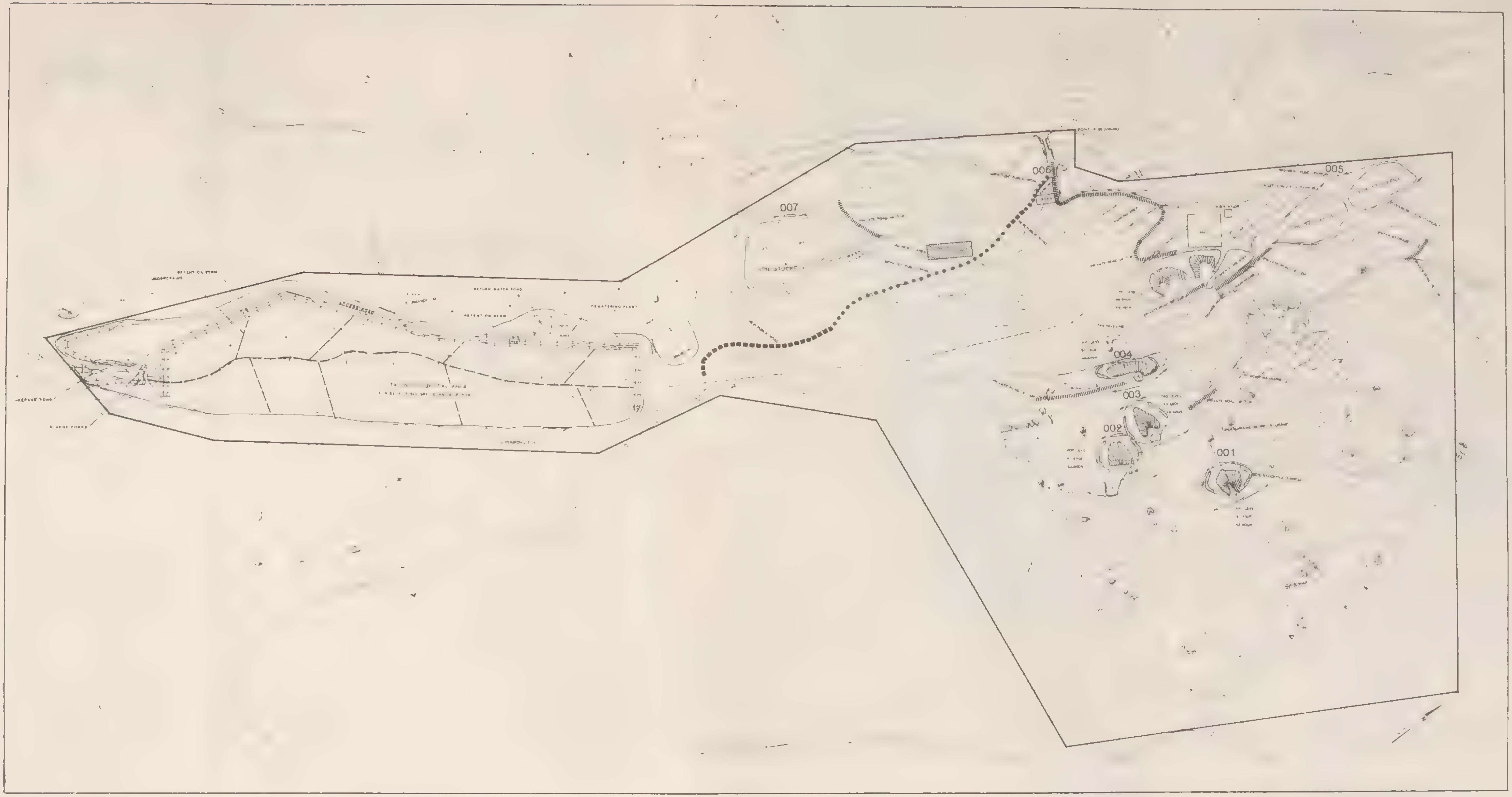

Figure I-2: Facilities Map

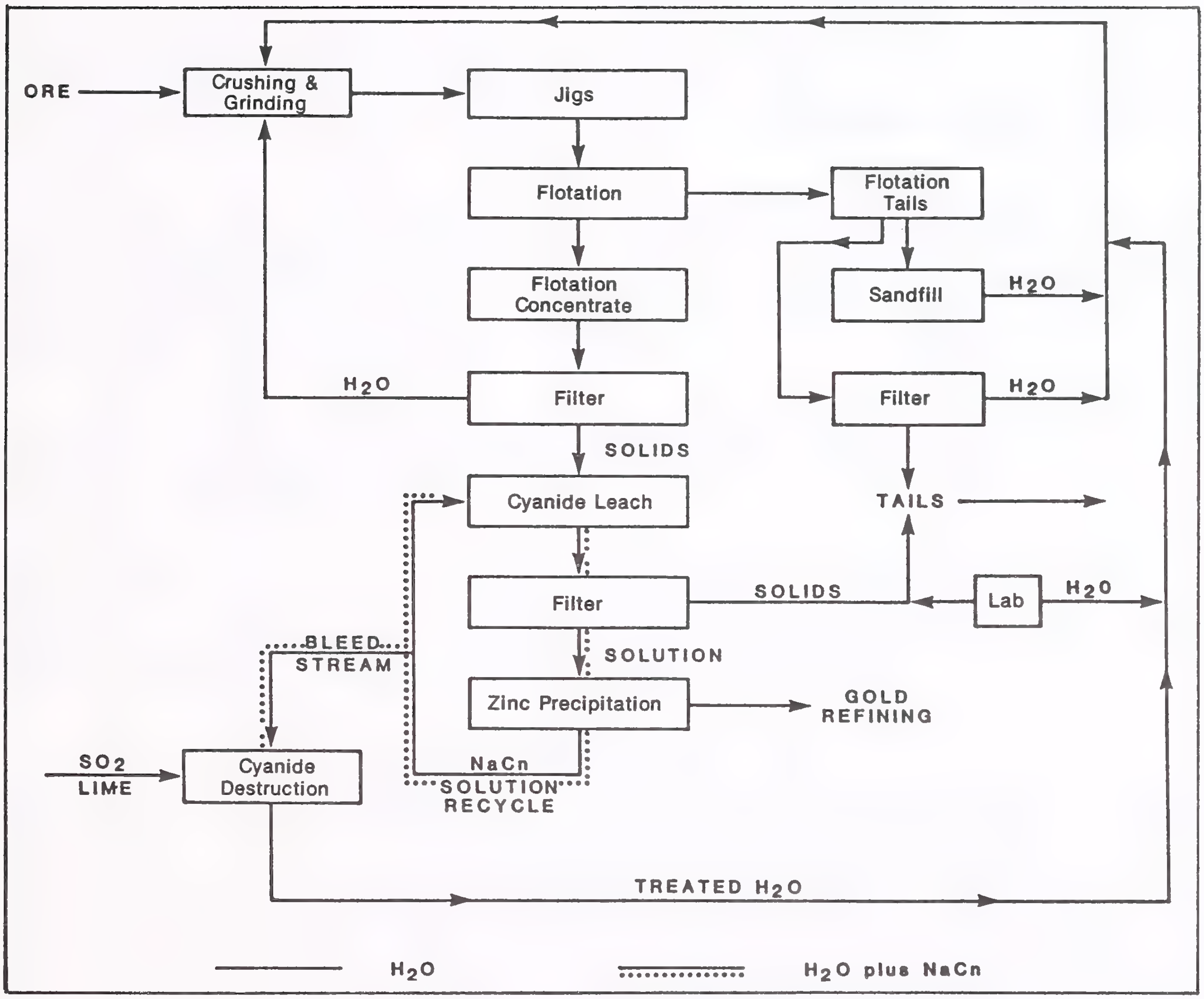

Table I-2: Simple flow chart of the milling process.

At the tailings disposal facility, water would be removed from the tailings slurry by a disc filter, belt filter press, or similar equipment, reducing the water content in the tailings to about 15 percent (see figure I-3). The water would be collected in a double-lined return water pond and pumped back to the mill for reuse. The capacity of the pond would be about 800,000 gallons; however, during normal operation the pond would contain only about 200,000 gallons of water. The dewatered tailings would be deposited using a conveyor-stacker operation. If the conveyor failed for a prolonged period, the dewatered tailings could be deposited by front-end loader, load-truck combination, or pneumatic pump system.

The tailings disposal facility would be constructed in four stages. Each stage would have the capacity for about five years at the projected production rate. Stage one would involve construction of the tailings dewatering and pumpback (process) plant and associated facilities. About 10 acres would be disturbed. Deposition of the tailings would begin at the downstream end of the dump. All aspects of the tailings pile would have a 33-percent slope

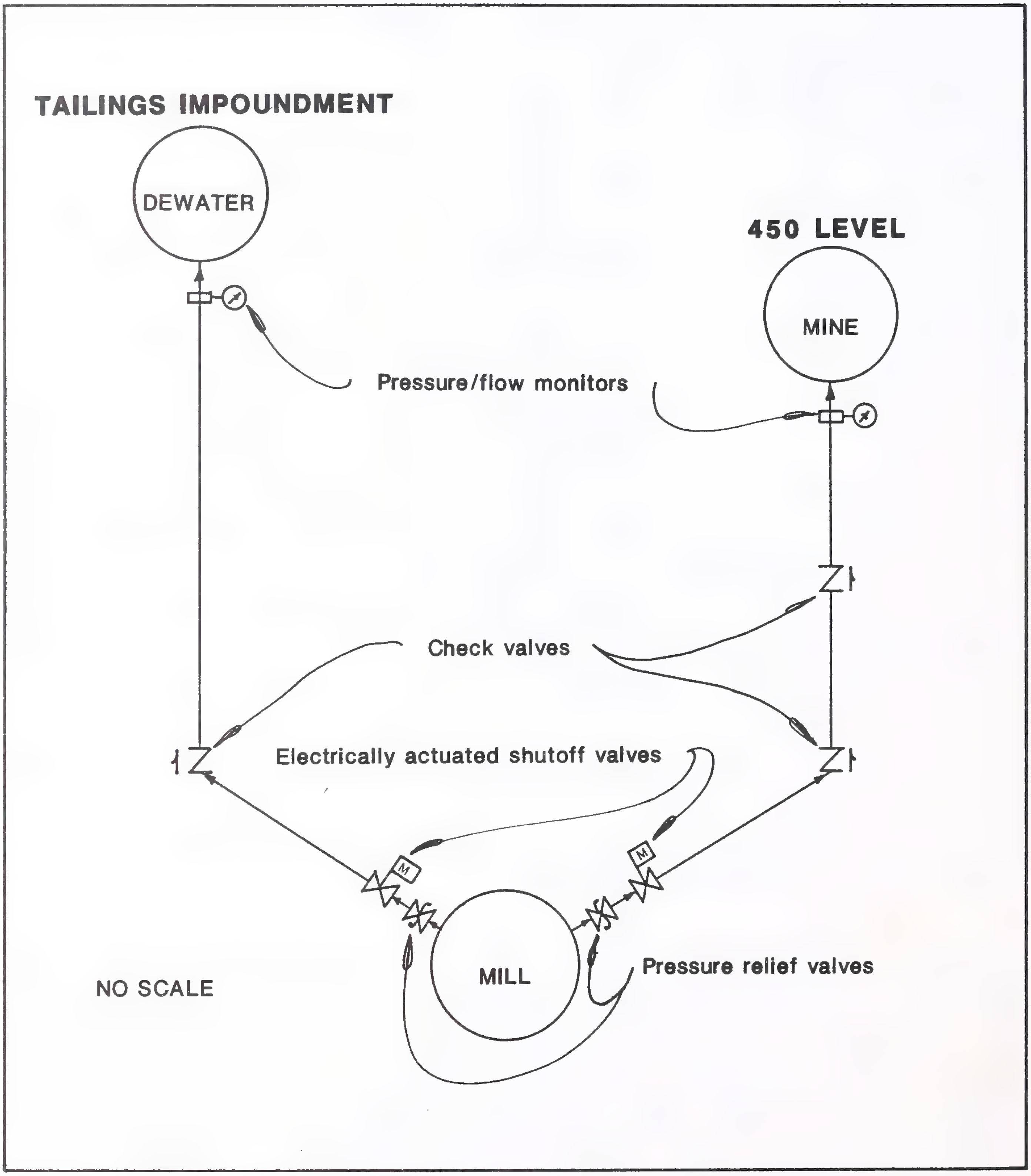

Figure I-3: Solid state controlling and monitoring hardware would provide failsafe features to reduce the potential for spillage from the slurry and backfill lines.

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except for the upstream working face. The active face would be steeper, developing at the natural angle of repose of the dry tailings--about 50 percent. As deposition continues, the face of the pile would advance upstream.

The maximum height of the pile would be about 125 feet. As the active face advances, the side slopes of the dump would be stabilized and reclaimed. The active face would vary in area between five and nine acres during the life of the project.

During stage two, the process plant would be moved upstream within the limits of the stage three dump area. The topography of the terrace is such that the impoundment would rest on the existing terrain without the need for embankment. The two existing historic tailings piles would be removed and placed within the stage two impoundment. The old tailings could be reprocessed before placement in the disposal facility.

During stage three, the process plant would be located outside the impoundment perimeter within the area previously occupied by the historic upper tailings impoundment. Again, no embankment need be constructed. Tailings deposition would continue upstream.

The process plant would remain in the same location during stage four. An embankment on the west and north side of the impoundment would be constructed to control runoff because the topography slopes gently toward Bear Creek. Deposition at the active face would be modified to achieve a 33-percent slope as the final limits of the dump are reached.

Tailings Disposal Facility. An embankment would be constructed around the lower end of the disposal area. The material for construction would come from within the disposal area. The internal slopes of the embankment would be 33 percent, and external slopes would be 40 percent. The embankment fill would consist of compacted sands and gravels six inches or less in size. Eighteen inches of finer-grained material and topsoil would be placed on the embankment and revegetated. The maximum height of the embankment would be 35 feet, where it crosses a minor drainage on the terrace. The remainder of the embankment would be less than 10 feet high. Throughout the length of the embankment, a 20-foot crest width would be maintained to allow access. The disposal area would have a minimum capacity of 3.5 million tons and would be designed as a zero-discharge facility.

Bentonite clay would be mixed into the native foundation material underlying the disposal site. A synthetic membrane liner would then be placed on top of the prepared foundation. An underdrain system would be placed on top of the synthetic liner. Water collected by the underdrain system would drain to a small lined seepage-collection pond at the downstream end of the dump. This pond would have a capacity of 1.2 million gallons. During normal operation, the pond would contain about 200,000 gallons; the remaining capacity would be used to accommodate a major flood event and fluctuations in the operating and hydrologic cycle of the facility. Water needed for ore processing would be pumped back to the mill.

The seepage-collection pond would be lined with a synthetic membrane liner similar to that used beneath the tailings dump. A leak detection system would be incorporated into the disposal facility. This system would consist of a series of collection pipes placed in a sand layer sandwiched between the synthetic liner and a prepared bentonite-soil layer. The pipe collection system would drain to a monitoring well.

The applicant's proposed tailings site is located at the southern boundary of the proposed permit area. Bear Creek flanks the west side of the site and Bald Mountain the east. The site is located on two terrace levels with a 75-foot elevation difference between them. The terrace is made up of glacial till or alluvial material deposited on top of alternating sequences of lakebed and older (high-energy) gravel sediments. The unconsolidated terrace deposits are over 300 feet deep in the central part of the valley.

Tailings Composition. The tailings would consist principally of fine-grained, silt-sized particles. The flotation tailings, which would be used to backfill empty mine stopes, would differ somewhat in chemical composition from the ore, primarily by having lower concentrations of heavy metals and sulfides including arsenopyrite. Most of the arsenopyrite and other heavy metals in the ore would be removed and sent to the cyanide circuit for further processing (see Appendix 1). Residual concentrations of milling reagents in the tailings would be non-toxic. The major chemical constituents of the flotation tailings would include silicates and iron. The flotation process would not use cyanide reagents; therefore, the flotation tailings would not contain cyanide.

Tailings in the tailings disposal dump would come from both the cyanidation and flotation mill processes. About 94 percent of the dump would be flotation process tailings and 6 percent cyanidation process tailings. The cyanidation tailings would contain relatively high levels of sulfides, manganese, iron, arsenic, silicates, and cyanide. Most of these constituents would be chemically and physically bound to other constituents in the tailings. Both bulk flotation and cyanide circuit tailings streams would be mixed before entering the tailings dump. Therefore, heavy metals, sulfides, and other compounds in the combined tailings would be intermediate in concentration. Major constituents of the combined dry tailings would also include silicates and sulfide compounds of iron and arsenic (about 1 percent total). The most common form of arsenic in the tailings would be arsenopyrite (an arsenic sulfide), a mineral common to the area. Sodium, calcium, and potassium compounds would also be of low concentrations. Cyanide compounds would occur in small concentrations--less than .05 to 1.3 ppm--in the tailings dump.

Water Use and Management

Project water use requirements are presented in Table I-3. Peak consumption would be about 3.31 cubic feet per second. During low-flow conditions, about 0.65 cubic feet per second would be consumed.

A storage tank of at least 60,000-gallon capacity would provide adequate surge capacity in case of a fire; reducing the total peak consumption to approximately 1.09 cfs. Of particular interest are the peak water requirements during low flow in Bear Creek. Because it is unlikely that appreciable quantities of water would be required for dust control and irrigation during the winter months, the peak consumption during this period is approximately 0.65 cfs.

The JJV proposes to upgrade the existing Pine Creek water source to provide water to the project. The Pine Creek point of diversion consists of an infiltration structure in Pine Creek which feeds a 4-inch line to the project.

Table I-3: Project Water Use Requirements

Use	Peak Consumption
Mine	
Sand Fill	11 gpm/0.03 cfs
Drilling	6 gpm/0.01 cfs
Diamond Drilling	5 gpm/0.01 cfs
Mill	
Operations	12 gpm/0.03 cfs
Tailings	6 gpm/0.01 cfs
Potable	5 gpm/0.01 cfs
Dust Control	
Roads	150 gpm/0.33 cfs
Waste Rock	42 gpm/0.09 cfs
Irrigation	10 gpm/0.02 cfs
Fire Protection	1,000 gpm/2.22 cfs
Contingency @ 20%	249 gpm/0.55 cfs
TOTAL	1,496 gpm/3.31 cfs

The infiltration structure would be approximately 30 feet in circumference. The 4-inch line from the infiltration structure would go into a 3,000-gallon, buried holding tank, which would provide a constant head to the project site. The existing system provides a flow rate of approximately 50 gpm.

This system would be upgraded by improving the infiltration structure and installing a 6-inch, buried pipeline. A 60,000-gallon storage tank would also be placed to provide surge capacity capable of providing a flow rate of approximately 500 gpm.

A secondary water source would consist of placing a portable pump in Bear Creek. A pump with approximately 600 gpm capacity would be used. The source would be employed as an emergency backup only. The secondary source would not require the installation of any permanent structures. Established minimum instream flows to protect aquatic life in Bear Creek would be insured.

Seepage from the tailings and any direct precipitation on the pile would be collected by the underdrain system and routed to the seepage collection pond. This water would then be pumped back to the mill via the dewatering plant.

Although unlikely, should the total dissolved solids in the recycle water get too high for mill-circuit makeup water, two sludge ponds would be constructed between the embankment and the seepage collection pond. The water would be treated to precipitate the dissolved solids before the water is returned to the mill.

Water draining from the tailings backfilled into the mine would be collected in ditches within the mine, routed to a sump, and pumped back into the mill circuit.

Surface water runoff from disturbed areas, topsoil piles, and waste rock areas would be collected by sediment collection ditches and routed to settling ponds. The ponds would be sized to retain the runoff from a 25-year, 24-hour storm. All runoff from adjacent, undisturbed areas would be collected by a series of trenches and diverted into the drainage below the seepage pond. When practical, water in sediment ponds would be used for irrigation and dust suppression. Best Management Practices (BMPs) would be used to control erosion during construction and operational phases of mining.

About 3,850 gallons per day would be routed into the septic system and discharged to a septic tank/drainfield system located 500 feet from Bear Creek adjacent to the mine office building. Design of the septic tank/drainfield system would be approved by the Montana Department of Health and Environmental Sciences prior to construction.

Utilities

The project would require about 3.5 megawatts of electricity, which the Montana Power Company (MPC) would supply. The applicant proposes that the power corridor would parallel and be adjacent to the county road from Gardiner to Jardine. Because the existing 12.5-kV transmission line cannot be converted to a 69-kV line, a new line would have to be built; the old line would be removed. The new line would be constructed with single wooden poles, equipped with a top "static" wire. Pole heights would be between 45 and 60 feet, and span lengths between the poles would be 300 to 350 feet. The MPC indicated that a reasonable corridor for the new power line would begin at the substation north of Gardiner, connect with the Jardine Road east of the substation, and then parallel the county road to Jardine (figure I-4, proposal).

Transportation

The applicant proposes to direct traffic to the mine through Gardiner using the existing county road and Z-Hill. The JJV has further committed to a plan to reduce mine traffic on the Jardine Road. The specific commitments follow.

1. The applicant would require management personnel to carpool from Gardiner to the minesite (Mountain International, Inc., 1984d).

2. When employment at the project reached 50, the JJV would provide cash incentives to encourage carpools. Drivers of vehicles would be paid cash bonuses based on the number of riders in each car. In addition, the JJV would issue only 50 vehicle parking passes for the minesite to further encourage carpooling.

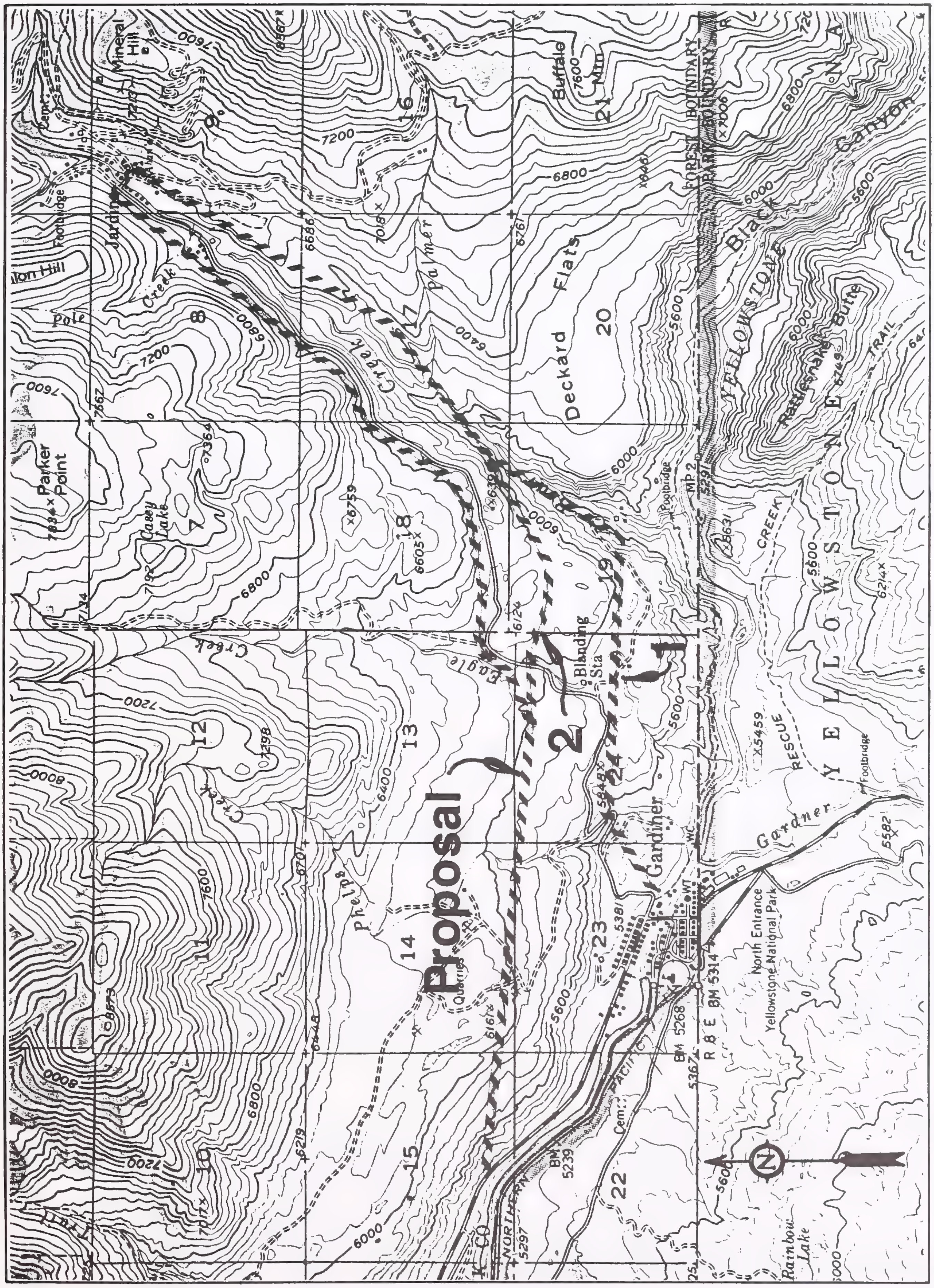


Figure I-4: Powerline corridor alternatives

3. When employment reached 100 people, the JJV would provide bussing between Gardiner and Jardine. One to two large-capacity busses would be used to transport the number of employees above 75. The county would provide land near the airport where JJV employees may park their cars and catch the bus.

4. The JJV and the county agreed to improve the Jardine Road in the hard-rock mine impact mitigation plan. The JJV would provide $500,000 to the county to upgrade the road when an operating permit has been obtained and when project construction has been approved by the JJV. The $500,000 would be a tax prepayment for which the JJV would receive credits against future tax liabilities. A detailed engineering study would be done to determine necessary road improvements. The grade would probably be reduced at some locations, guardrails would be installed, sight distance would be improved through some curves, and drainage and dust control would be added (R.T. Agar, Vice President, American Copper and Nickel Company, Inc., written comm., February 6, 1986).

The JJV would also schedule shift changes to avoid peak use times on the Jardine Road. Day shift would begin at 7:00 a.m., concentrating mine traffic between 6:30 and 7:00 a.m. The evening shift would begin at 3:00 p.m., concentrating traffic between 3:00 and 3:30 p.m. The night shift would begin at 11:00 p.m. Most mine-related travelers would be off the Jardine Road by the time other travelers head to work in the morning and during times the school bus uses the road (R.T. Agar, Vice President, American Copper and Nickel, Inc., written comm., January 22, 1986).

To access the mine from the Jardine Road, the applicant proposes to use the present Jardine access road by widening or replacing the existing bridge (figure I-2).

Mine Employment

During the 18-month construction period, the applicant and its construction contractor would hire as many as 65 people, with a quarterly average of 45 employees.

The 30 administrative and laboratory personnel, and 20 maintenance/shop employees would work a regular day shift, five days a week. The 75 underground miners would work two shifts per day, five days a week. The 25 mill operators would work three shifts per day, seven days a week. About nine months after construction is complete, employment would stabilize at 150.

Bonding

The applicant must file a bond with the Department of State Lands (DSL) of not less than $200 and not more than $2,500 for each acre disturbed. Despite these limits, however, the bond must not be less than the estimated cost to the state of reclaiming the disturbed lands (82-4-328[1], MCA). The bond would not be released until DSL and the U.S. Forest Service determine that reclamation has been completed successfully.

The Forest Service may require additional bonding if it determines that the bond held by DSL is not adequate to reclaim national forest lands or is not available for Forest Service requirements. The bond amount would equal the estimated cost of stabilizing, rehabilitating, and reclaiming the area of operations on national forest system lands. The bonding level would be adjusted if the plan of operations were modified.

Reclamation

All structures would be dismantled and sold as salvage or relocated to another project upon completion of operations. Building foundations would be removed and disposed of in the final unit of the tailings disposal site or portions may be buried in the facilities area during grading. The ore stockpile would be removed and milled. The tailings pipelines would be removed at the end of operations. After mining is complete, all mine openings would be sealed temporarily or permanently, depending on whether access is required. If activity at a particular level is complete before the end of operation, reclamation would be conducted when activities are finished at that level. All remaining waste rock dumps would be reclaimed at the conclusion of mining. All unsalvaged mining debris would be buried at the end of operations. All solid waste disposal would be in compliance with local and state ordinances.

Cut-and-fill slopes on roads to remain after mining would be reclaimed during the first appropriate season after construction or improvement. This reclamation includes new segments of the county road and existing roads on Mineral Hill that are minimally improved for access. Roads not proposed as part of the post-operation land use would be reclaimed at the end of operations.

Interim revegetation on soil stockpiles, the slurry-line corridor, sediment-control structure areas, tailings disposal site embankment, and areas disturbed during facilities construction would occur during the first appropriate season after construction. Final reclamation on these sites would occur when the project is over.

The tailings disposal site would be reclaimed in stages. After year 2, about 2.3 acres per year would be reclaimed. The seepage-collection pond downstream of the impoundment, and one permanent diversion above and to the east of the tailings disposal site would not be reclaimed. The existing upper tailings pond would be reclaimed in conjunction with tailings disposal during the second phase of the operation. No time frame has been established for removing and reclaiming the existing lower tailings pond.

The applicant's stated reclamation goals are:

--reestablishing wildlife habitat, particularly on the tailings disposal area and on Mineral Hill,
--providing for domestic livestock use, particularly in the facilities area,
--protecting water quality in Bear Creek,
--providing public access to federal lands, and
--protecting public health and safety by removing potential hazards (primarily mine openings and facilities).

Monitoring

Revegetation success would be monitored by sampling reclaimed areas one year after starting reclamation. Reclamation and revegetation would be analyzed for several years after reclamation is initiated.

The slurry and backfill lines would be monitored for leaks by:

--continuous flow balancing at the mill and process areas,
--an alarm system and emergency shut-off control system,
--daily visual inspections,
--other electronic or mechanical means developed during design.

Settling ponds would be inspected in the spring and fall, and cleaned when the sediment accumulation exceeds 12 inches. Ditches would be inspected annually, and erosion and bank damage repaired until bond release.

Surface water from Bear Creek would be sampled both upstream and downstream from the operation. Special sampling would be done as needed--after discharges from sediment control structures, for example. A comprehensive ground water monitoring program would be developed in consultation with the Department of State Lands, the Department of Health and Environmental Sciences, and the U.S. Forest Service.

Embankment material surrounding the downstream and upstream ends of the dump would also be monitored to detect settlement or horizontal movement. Survey monuments would be installed along the embankment crest and along the crest of the slope above Bear Creek. If movement were detected from the survey data, additional monitoring equipment, such as inclinometers, would be installed to characterize the extent and location of movement. Should the movements be determined to have potential impact on the tailings facilities, remedial measures would be taken to protect the facilities.

ALTERNATIVES

Alternatives to the applicant's proposal are evaluated in the EIS. These include a county road alternative that would bypass the eastside Gardiner residential and commercial area, alternative tailings disposal locations, alternative corridors for a power line to supply electricity to the project, and alternative mine-access roads.

The following section describes the alternatives. Chapter IV analyzes the consequences of each alternative. Chapter III analyzes the consequences of the applicant's proposal.

County Road Alternatives

The applicant's proposal to reconstruct the Jardine Road using existing and new right-of-way would route traffic through the residential east side of Gardiner. In addition, the applicant proposes a plan to reduce traffic on the Jardine Road.

Two county road alternatives were identified that would bypass Gardiner (figure I-5). Alternative route A would start near the airport, gradually climb the steep hillside, and connect with the existing county road above Z-Hill. Alternative route B would start at Highway 89 just west of Gardiner and climb the hillside just north of Gardiner. This alternative is not considered feasible because of slope steepness. In addition, the amount of rock that would have to be removed during construction would pose a safety hazard to residences living at the toe of the slope. Both alternatives would be used for the life of the project only. After mining, the roads would be closed and the surface reclaimed. During and after the project, the Jardine Road would remain open to the public.

Alternative route A is considered the only reasonable alternative to the applicant's proposal. This alternative would route project traffic around the town of Gardiner.

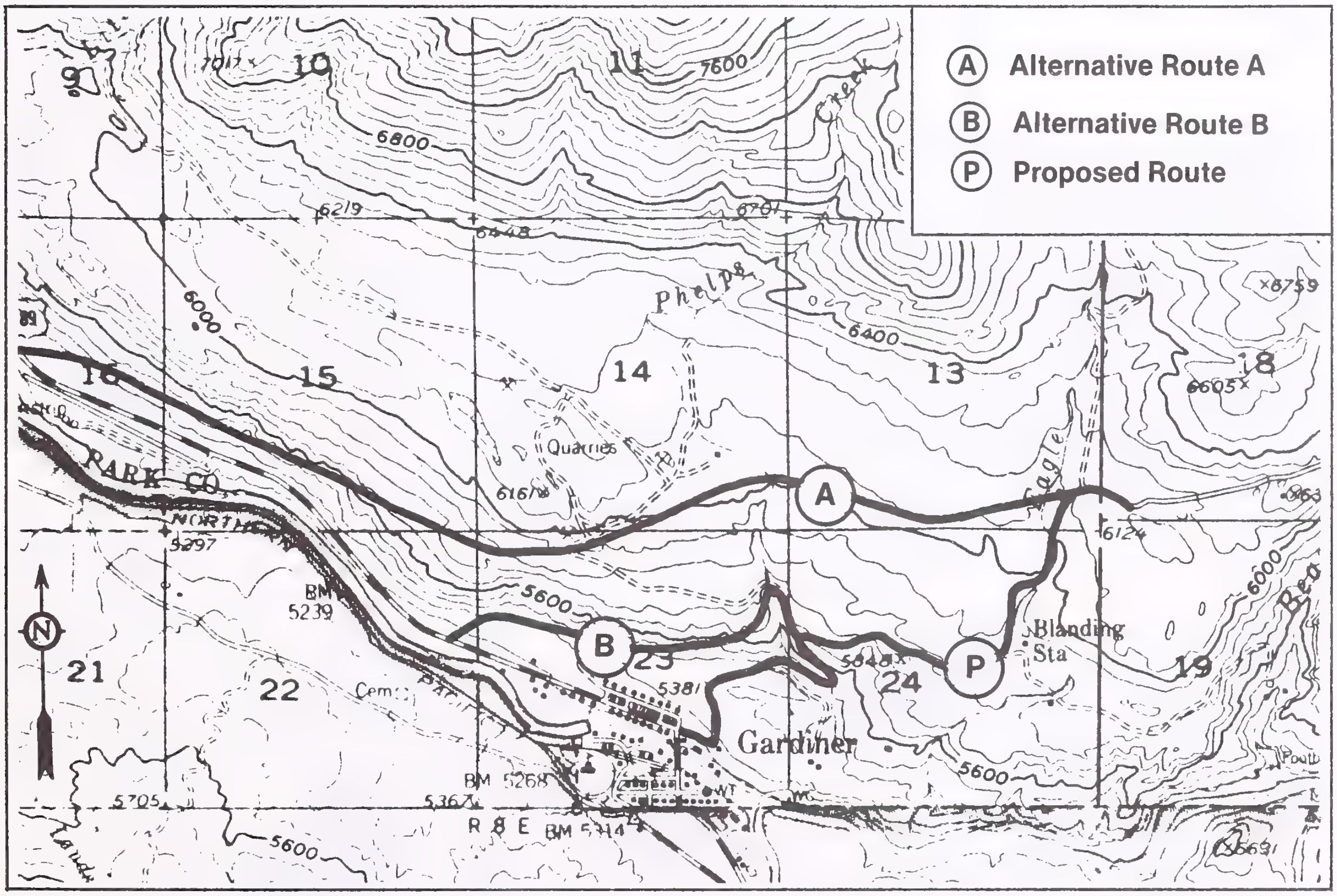


Figure I-5: The company proposes to upgrade the existing county dirt road (P) out of Gardiner. The agencies identified two alternative routes (A and B) that would avoid the town.

Tailings Disposal Site Alternatives

Only three areas suitable for tailings disposal were identified within a 10-mile radius of the applicant's project. These included the proposed tailings disposal area, Deckard Flats, and the terrace area above Gardiner. Wilderness and national park boundaries, unsuitable topography, conflicting land uses, natural hazards, and wildlife travel corridors within this 10-mile radius limit suitable sites to these three areas.

From these areas, three alternative disposal sites (sites 2, 3, and 4) were identified (figure I-6). These sites and the proposed site (site 1) were evaluated by Steffen Robertson and Kirsten, Inc., in the applicant's permit application (1984), and by DSL and USFS personnel. The engineering feasibility of all four sites was assumed to be about the same. However, none of the alternatives provided significant advantages over the applicant's proposal and, for this reason, all were eliminated from further study. The following is a description of the alternatives and a brief summary of the agencies' reasons for dismissing them from further study.

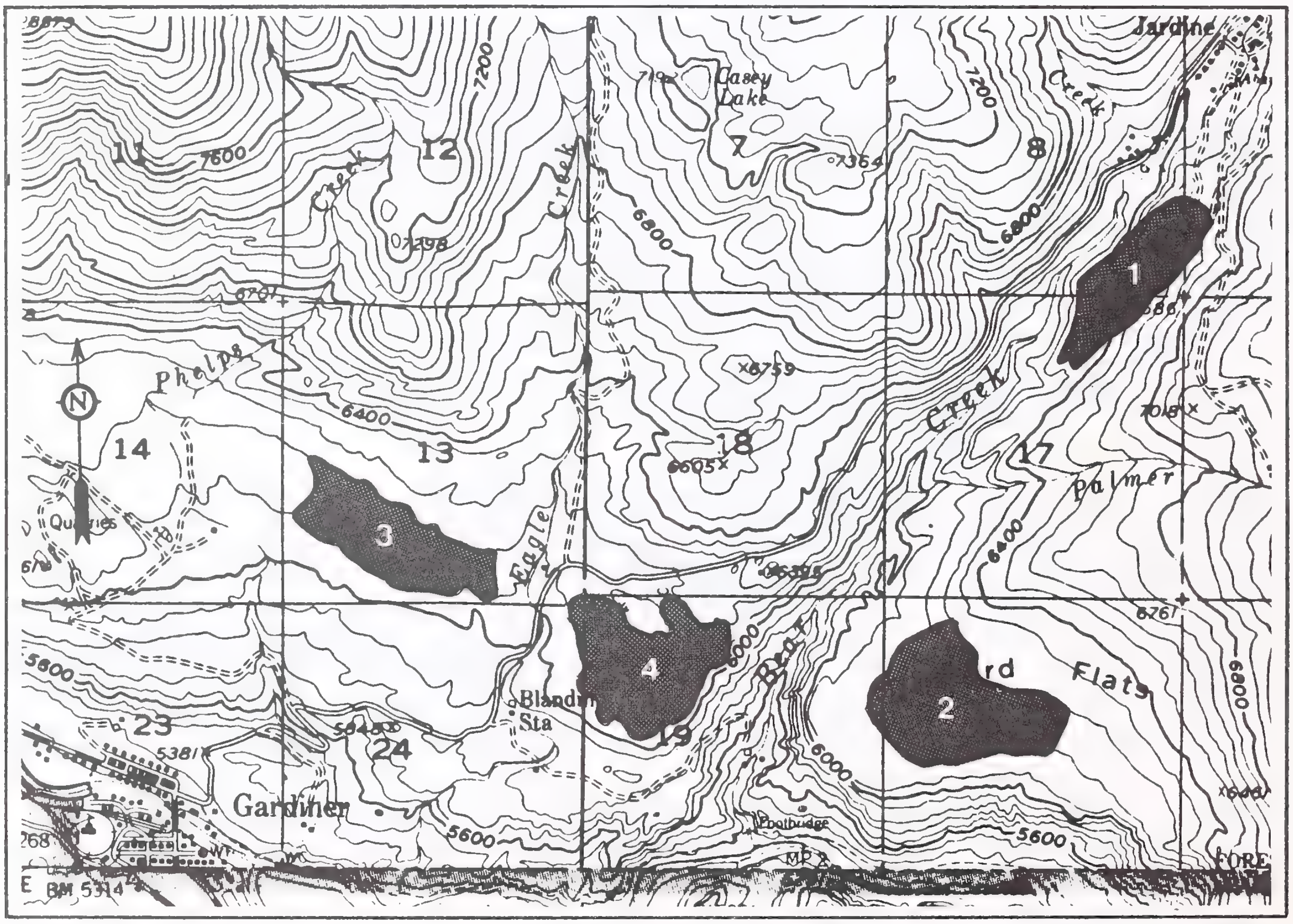


Figure I-6: Four tailings disposal sites were analyzed. Sites 2, 3 and 4 were dismissed because of major environmental problems. Site 1 is the applicant's proposed site.

Site 2 is located about 2.5 miles south of the project area at Deckard Flats, on an elevated terrace on the east side of Bear Creek at its confluence with the Yellowstone River. The site is covered by a thin veneer of glacial till and alluvial material over a highly fractured basalt. The basalt lies over a deposit of sands, gravels, and boulders. Total thickness of these materials exceeds 250 feet. Tailings from the mill would be transported to the disposal site in a 2.5-mile slurry pipeline that would parallel Bear Creek and cross Palmer Creek. The tailings would be dewatered and disposed of in a dump similar to the applicant's proposal.

Compared to the applicant's proposal, site 2 would be highly visible from Yellowstone National Park and from around Gardiner. It is also located in an elk winter concentration area and is near bighorn sheep habitat.

Site 3 is located about three miles southwest of the project on a gently sloping terrace above the Yellowstone River about one mile north of Gardiner, Montana. The geology of the site is similar to that of site 2. Tailings would be transported to the disposal site in a slurry pipeline that would cross Bear and Eagle Creeks and parallel Bear Creek for about three miles. The tailings would be dewatered and disposed of in a dump similar to the applicant's proposal.

Compared to the applicant's proposal, site 3 would be highly visible to park visitors traveling from Mammoth Hot Springs to Gardiner. This site is located on the fringe of an elk winter concentration area and within the late-season elk hunting area. In addition, the site is located only 1 mile upstream from Gardiner and 3/4 mile upstream from a residential area. The city of Gardiner currently derives about 225 gpm from a spring in the vicinity of site 3.

Site 4 is located near the U.S. Forest Service Blanding Station between sites 2 and 3, on a terrace west of Bear Creek near the confluence with the Yellowstone River. The geology at this site is also similar to that of site 2. Tailings would be transported three miles to the disposal site in a slurry pipeline that would cross Bear Creek. Disposal of tailings would be similar to the applicant's proposal.

Compared to the applicant's proposal, site 4 would be highly visible from Yellowstone Park and around Gardiner. People now live adjacent to the downstream boundary to the site. The site is within both elk winter range and the late-season hunting area. Site 4 could have slightly more impact on grizzly bear. It is located near an apple orchard at Blanding Station where as October, 1981, seven grizzlies were sighted (Knight et al., 1982 in Westech 1984).

In summary, none of the disposal site alternatives offers distinct advantages when compared to the applicant's proposal. Therefore, these alternatives are not considered further in the EIS.

Power Line Corridor Alternatives

The agencies have evaluated two alternative power line corridors in addition to the applicant's proposal (figure I-4). Alternative 1 would be an upgrade of the existing power line that passes through Gardiner and up Bear

Creek to service Jardine. The old line would be removed and replaced with a 69-kV power line.

The corridor for alternative 2 would extend east from the Gardiner substation to Bear Creek, crossing the county road south of Eagle Creek campground. The corridor would cross Bear Creek immediately and follow the existing power line route to Jardine. The existing power line in Bear Creek would be removed. The new power line, as with the proposal and alternative 1, would be a 69-kV line.

Mine Access Road Alternatives

Two mine-access road alternatives evaluated in the draft EIS would avoid the removal of five historic structures in Jardine. Following the publication of the draft EIS, the JJV revised its proposed mine access road plan. The new plan would use the existing bridge (widening or replacing the bridge, if necessary) and the existing road into Jardine. The new access plan would avoid removal of the historic structures--the main reason for mine-access road alternatives--and would cause less surface disturbance. The two mine-access road alternatives are not considered in the final EIS because they offer no distinct advantage over the revised proposal.

The Preferred Alternative

The agencies' preferred alternative is the applicant's mining and reclamation proposal, plus mitigating measures and the power line corridor alternative 2. The agencies' mitigating measures provide that:

1) The applicant would monitor for seepage under the return water pond, sludge ponds, and seepage collection pond, as well as under the lined tailings dump. The applicant would submit for agency approval an operational ground water monitoring plan that conforms with state of Montana guidelines developed for ground water monitoring of hazardous wastes.
2) The applicant would limit the active area of the working face of the tailings dump to less than six acres to reduce seepage and maintain confidence in the impoundment's ability to handle catastrophic precipitation/snowmelt events. A small active area would also help mitigate problems associated with wind erosion of exposed tailings.
3) The applicant would fill the seepage collection pond and return water pond with bank material and reclaim the surface after all residual solutions have drained from the tailings.
4) The applicant would store all hazardous chemicals in durable containers in an area surrounded by impermeable containment structures.
5) The applicant would stabilize the diversion channel of the tailings dump by covering the upper, gentler segment of the channel with small-sized riprap (nominal size 6 to 10 inches) and the lower, steeper segment with larger (nominal size 50 inches) riprap. An alternative would be to lessen the channel gradient by slightly modifying the shape of the dump and by moving the dump a few hundred feet further upstream (northeast).

6) The applicant would submit for agency review and approval, the final design specifications for stabilizing the diversion channel of the tailings dump. These specifications will include channel gradient, width, slope lengths, riprap dimensions, and other pertinent information to determine the stability of the final design.
7) The applicant would construct the mill building so that it can withstand a peak horizontal acceleration of 50 percent of gravity.
8) The applicant would construct a 7- to 7-1/2-foot-tall, woven-wire fence around the return water pond.
9) The applicant would store food and dispose of garbage according to the Grizzly Bear Standards and Guidelines for Gallatin National Forest (U.S. Forest Service, 1984).
10) The U.S. Forest Service, in conjunction with the Montana Department of Highways, would finalize a joint road maintenance and management plan containing a provision to remove carrion from highways in grizzly bear range. The plan would be extended to cover U.S. 89 between Gardiner and Tom Miner Basin (western boundary of the Hellroaring/Bear [Creek] Bear Management Unit).
11) The applicant would paint structures relating to the project to blend with the natural environment.

A number of mitigating measures identified in the draft EIS are not included in the agencies' preferred alternative. A summary of the mitigating measures and the reason for excluding them from the preferred alternative follows.

1) Hydrology (refer to pages III-12 and III-14 of the DEIS)

- --Use water collected in sediment ponds for irrigation and dust control. The applicant committed to this measure in the revised application.
- --Use of soil erosion control practices. The applicant committed to this measure in the revised application.
- --Delay of earth moving to avoid wet season. The applicant committed to this measure in the revised application.
- --Installation of an alarm system and emergency shut-off valve for the slurry line. The applicant committed to a spill detection and control system in the revised application.
- --Special design of slurry transport pipelines to resist corrosion and abrasion. The applicant committed to this measure in the revised application.
- --Toxic sulfide flotation should be disposed of in the lined tailings dump. The applicant committed to this measure in the revised application.
- --Limit mine development to a depth of 6,663 feet. Additional environmental review and agency approval would be required if mining below the 6,663 foot level would cause a significant change in the underground hydrologic system.
- --Mine water discharges. Applicant committed to grouting of fractures and sealing of ditches and sumps within the mine.
- --Water monitoring of seepage collection pond. The applicant committed to this measure in the revised application.

2) Vegetation (refer to pages III-29 and III-30 in the DEIS)

--Fall planting of seeds. Although spring seeding does not have the advantages of fall seeding, it would be an adequate approach to revegetation. In addition, the reclamation plan addresses the possibility of fall seeding.

--Using clean straw mulch. It is in the applicant's own best interest to control weed growth. Although not specified in the application, Jardine Joint Venture may be planning to use a clean mulch.

--Scalping or applying herbicides. Planted shrubs could reach adequate density. This measure, therefore, would be implemented only after evaluating shrub survival.

3) Wildlife (refer to pages III-37 and III-38 in the DEIS)

--Monitoring deer and elk use of the tailings area. The applicant's revised application includes a monitoring and contingency plan. The applicant has also committed to building an exclosure fence around the seepage collection pond.

--Reducing mine-traffic/hunter-vehicle conflicts. The applicant's revised application includes a proposal that would lower mine-related traffic.

--Reducing road kills. The applicant's revised application includes a proposal that would lower mine-related traffic along the Jardine Road. The decrease would reduce the chances of vehicles striking wildlife. Other mitigations (game crossing signs, lowered speed limits, fencing) would be implemented only if problem-road sections were identified. These mitigations would fall under the jurisdiction of the Montana Department of Highways or the Park County Commission.

--Lowering poaching and wildlife harassment. R.T. Agar (Jardine Joint Venture, pers. comm., January 22, 1986) stated that current policy provides for dismissal of fish and game law violators.

--Restricting access to big game winter ranges. This measure would be at the discretion of the U.S. Forest Service.

--Limiting the period of major construction. The applicant's reclamation plan commits to handling soil only during periods of good tilth. These periods would probably occur when elk use of the permit area is low (late spring--late fall).

--Modifying timber sales. The U.S. Forest Service has committed to following guidelines in the Coordinating Elk and Timber Management Handbook (Montana Cooperative Elk-Logging Study Committee, 1985). They have also indicated that logging would be designed to minimize impacts on elk calving.

4) Threatened and Endangered Species (refer to III-39 and III-40 in the DEIS)

--Monitoring grizzly bear use of the tailings area. The applicant's revised application includes a monitoring and contingency plan. The applicant has also committed to constructing an exclosure fence around the seepage collection pond.

--Reducing poaching and wildlife harassment. R.T. Agar (Jardine Joint Venture, pers. comm., January 22, 1986) stated that current policy provides for dismissal of fish and game law violators.

--Decreasing grizzly bear attractants in Jardine. Significant additions to Jardine's population are not projected. Therefore, levels of discarded food would remain similar to baseline conditions. The measure would be at the discretion of the Jardine Joint Venture.

5) Transportation (refer to pages III-70 and III-71 of the DEIS)

--Requiring or encouraging carpooling of employees living north of Gardiner. Projected traffic increases on Highway 89 are not significant to warrant carpooling of employees from Livingston.

--Financial incentives for carpooling. The applicant's revised application provides for financial incentives for carpooling.

--Upgrading Jardine Road. The applicant's hard-rock mitigation plan provides for payments to the county for upgrading the Jardine Road.

--Shuttle service for employees. The applicant's revised application provides for a strict transportation reduction plan which provides for bussing between Gardiner and Jardine when employee numbers reach a certain number.

6) Cultural Resources

--Develop a mitigation plan. The applicant has committed in its revised application to exercising the recommendations made in its mitigation plan.

--Reuse of existing structures. The applicant has committed to this measure.

--Relocation of the mill. The applicant has committed in its revised application to remove and store features, such as the fly wheel, that would be affected by the location of the mill.

--Closure of all buildings. The applicant has committed to this measure in the revised application.

Chapter II: The Existing Environment

GEOLOGY

The geologic setting of the Gardiner/Jardine area is strongly influenced by geologic events that have occurred in the greater Yellowstone Park/Beartooth Mountain area. Very old metamorphosed marine deposits--some as old as three billion years--dominate the area north and east of the Gardiner fault (see figure II-1). These sediments host the gold-bearing ore that the applicant proposes to mine. Volcanic sediments formed massive quartz-rich horizons bearing minor amounts of gold, sulfides, and tungsten (scheelite), interbedded with quartz-biotite schists and biotitic quartzites.

The remains of volcanic activity dot the landscape of the greater Yellowstone region. Some of the oldest volcanic rocks date back over 50 million years; the most recent are less than two million years old. Consolidated ash deposits, lava flows, and crystallized magmatic intrusions were the end results of these volcanic events, similar to the dramatic processes witnessed during the 1980 eruption of Mount St. Helens in Washington.

Three episodes of glaciation over the last million years have left glacial debris and glacial-related deposits and lakes scattered across the region. More recent processes of erosion and stream action have further modified the landscape. Bear Creek and the Yellowstone River in the Gardiner/Jardine area are in the process of active downcutting. Thick glacial-related valley-fill deposits in the Jardine area are being eroded by downcutting and the gradual meandering of Bear Creek.

Topography

Gardiner is located at an elevation of about 5,300 feet; Jardine lies at about 6,500 feet. The Gallatin Range forms the western boundary of the Yellowstone Valley, and the Absaroka and Beartooth Mountains are to the east. Locally, these mountains exceed 9,000 feet, towering well above Bear Creek and the Yellowstone River.

The project area is on the south side of Bear Creek, adjacent to the historic town of Jardine. Mineral Hill forms the southeastern margin of the permit area; the top of the mountain is about 7,600 feet. The Bear Creek side of the hill is steep, exceeding 50 percent slope in many places. The valley bottom of the permit area (at 6,300-6,500 feet) is flat to moderately sloped (less than 20 percent).

Bedrock of Mine Area

Ancient, metamorphosed marine sediments host the gold-bearing ore that the applicant proposes to mine. Volcanic sediments were metamorphosed and formed massive, quartz-rich horizons bearing minor amounts of gold, sulfides, and tungsten (scheelite), within quartz-biotite schists and biotitic quartzites.

Iron-chemical precipitates, which formed during periods of stability when volcanic activity subsided, contain higher sulfide, gold, arsenic, copper, and iron concentrations than the volcanic sediments. Minerals in the gold-bearing zone include arsenopyrite, pyrrhotite, pyrite, chlorite, quartz, and amorphous carbon (project application, 1984).

The thickness of the gold-bearing strata of Mineral Hill varies from just a few inches to as much as 75 feet thick. Gold ore grades range from a trace to high-grade, nugget-bearing ore. The average production grade would probably run about 0.20 ounces per ton (Olin Hart, Homestake Mining Company geologist, pers. comm., June 4, 1985).

The original layer-cake sequence of deposits has been folded, twisted, and uplifted over 10,000 feet by the several periods of deformation that followed. A cross-sectional view of the underground workings of Mineral Hill is depicted in figure II-2. The Bear Gulch fault, which cuts through the center of Mineral Hill, offsets the bedrock 100 to 300 feet, west side down. For this reason, underground mining has been confined primarily to the western half of the hill.

Surface Deposits of Bear Creek

At Jardine, Bear Creek was forced to the western edge of the valley by the thick glacial terrace deposits. Up to a third of the original deposits has been removed from Jardine since the last episode of glacial deposition some 8,500 to 13,000 years ago. Drilling records of wells completed in the Bear Creek terrace indicate it is composed of alternating sequences of gravels and lake bed sediments. At least three complete cycles of deposition are preserved, starting with a lakebed deposit at the bottom and culminating in a gravelly layer at the top. The lakebed deposits vary from about 50 to 100 feet thick in this terrace.

Undercuts along the terrace above Bear Creek and seeps discharging from the banks have caused small slumps of the terrace adjacent to Bear Creek. Two slumps adjacent to the existing unreclaimed upper tailings dump have occurred since 1971. During the early 1970s, the Anaconda Copper Company, temporary owner of the Jardine properties, kept the tailings pond covered with water to hold down dust. Some of this water seeped into the underlying terrace and created a perched water table at depth on top of the lakebed sediments (see

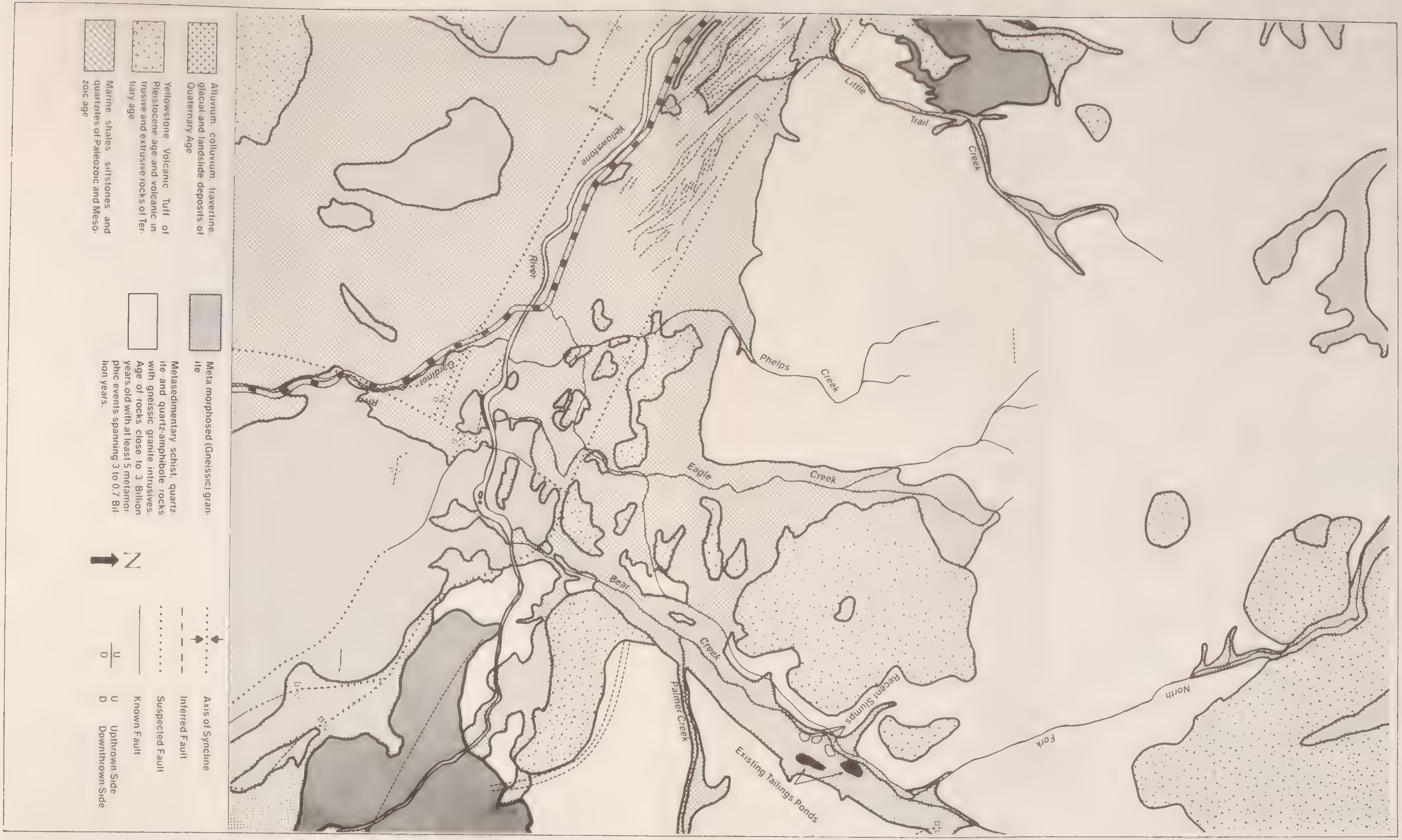

Alluvium, colluvium, travertine, glacial and landslide deposits of Quaternary Age
Yellowstone Volcanic Tuff of Pleistocene age and volcanic intrusive and extrusive rocks of Tertiary age
Marine shales, siltstones and quartzites of Paleozoic and Mesozoic age
Metamorphosed (Gneissic) granite
Metasedimentary schist, quartzite and quartz-amphibole rocks with gneissic granite intrusives. Age of rocks close to 3 Billion years old with at least 5 metamorphic events spanning 3 to 0.7 Billion years.
N
Axis of Syncline
Inferred Fault
Suspected Fault
Known Fault
U Upthrown Side
D Downthrown Side
Yellowstone
River
Gardiner
River
Little
Trail
Creek
Phelps
Creek
Eagle
Creek
Bear
Creek
Palmer Creek
Recent Slumps
Existing Tailings Ponds
North
Fork

Figure II-1: The geology of the project area reflects its origins of Precambrian bedrock, volcanic formations, and more recent, unconsolidated deposits.

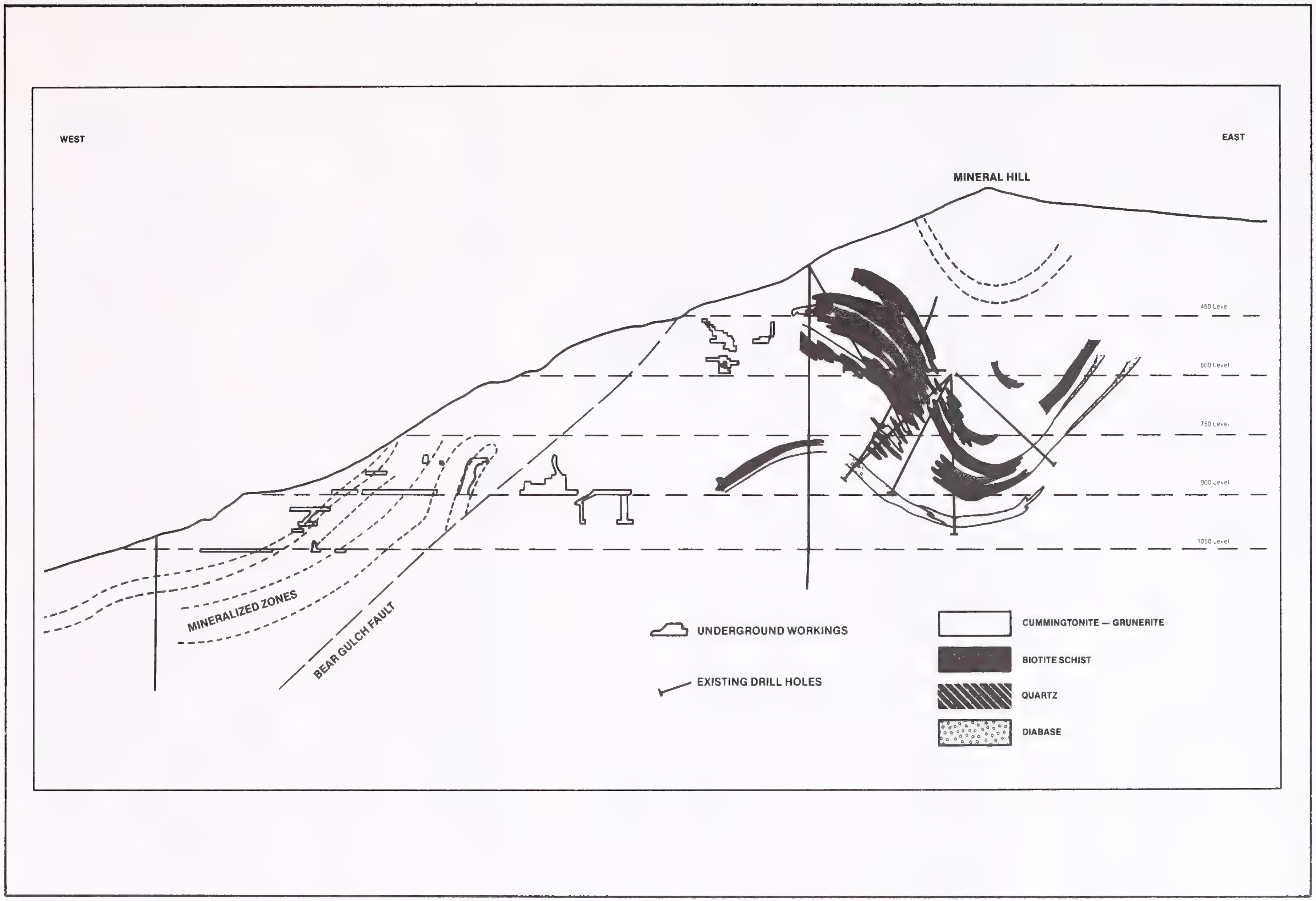


Figure II-2: Historic mining operations removed most of the gold-bearing ore from the mineralized zones west of the Bear Gulch fault. The applicant proposes to mine the gold-bearing zones (cummingtonite/gruenerite, biotite schist, quartz) east of the fault.

figure II-3). The added water, together with stream undercutting, caused two small sections of the oversteepened cutbank to slough off into the creek.

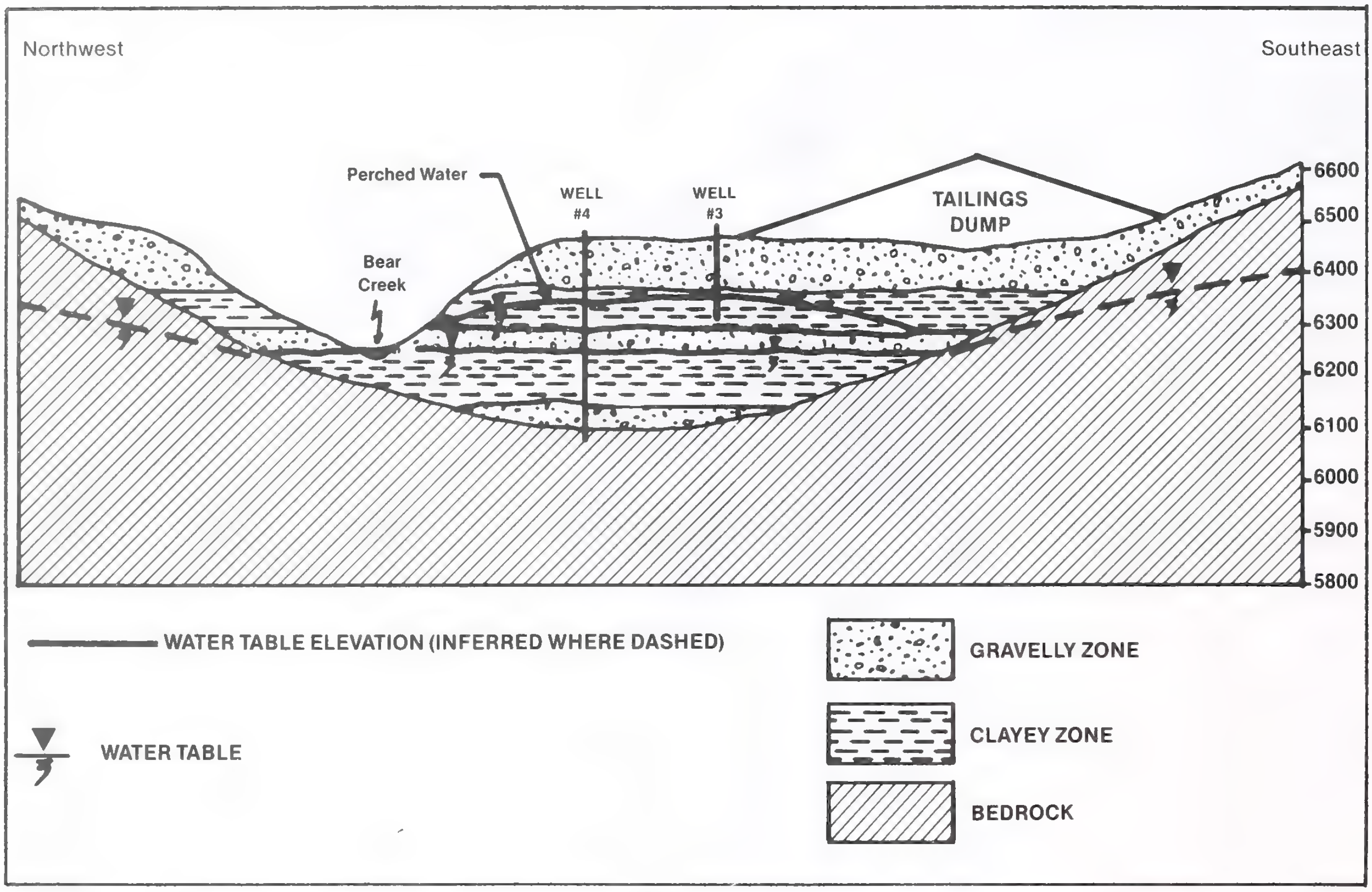


Figure II-3: The tailings dump would sit atop a high terrace of Bear Creek. The terrace is composed of layers of glacial gravels and clayey lake bed sediments. Ground water movement in the bedrock is generally toward the valley bottom. Within the valley alluvium, it moves downstream toward the Yellowstone River.

An older slump upstream of these two recent slumps indicates that slumps are a natural erosional process. Saturation of the old tailings by the Anaconda Copper Company probably accelerated the process.

Faulting and Earthquakes

Earthquakes are a result of two rock masses moving rapidly past each other along a fault. The energy released during an earthquake travels radially through the earth and is lost quickly. No local damage would be caused by an earthquake if it originated over 120 miles from the site. Within a 120-mile radius, locations of active faults and the strength and location of historically recorded earthquakes were used to determine the probability of occurrence of various degrees of ground shaking at Jardine (project application, 1984, p. 1-C-19). The results are presented in appendix 6.

The maximum credible earthquake likely to occur in this region would measure about 7.3 magnitude on the Richter scale (Hags, 1980, in project application, p. 1-C-36). Such a large earthquake within 10 miles of Jardine would create considerable damage, even to well-built wooden structures. The ground and roads would be cracked badly in places, and mass failures, such as slumps into rivers, would be common. However, such a large event would probably occur about once every 10,000 years. Based on available data, ground shaking strong enough to cause measurable damage to well-built buildings in Jardine would likely occur only once every 7,000 years or so; ground shaking of less intensity would affect Jardine more often. For example, the degree of ground shaking similar to that caused by the magnitude 7.1 earthquake at Hebgen Lake (Jardine intensity VI) would occur approximately once every 50 years. This quake was strong enough in Jardine to frighten residents and cause some minor damage to homes (broken windows and falling plaster, etc.), but did not result in serious, permanent damage to life or property. Although the Greater Yellowstone area is susceptible to recurrent earthquake activity, it is less seismically active than other regions of the United States, such as California, Washington, and Alaska, and the world, such as Japan and China (also see appendix 6).

Several active faults (showing movement within the last one to two million years) converge on the Gardiner area. These include the Gardiner Fault (15 miles long), the Mammoth Fault (8 to 10 miles long) and the Pine Creek or East Gallatin Fault (20 miles long) (Witkind, 1975). The Gardiner Fault shows evidence of 400 feet of offset over the last two million years. From this information it was estimated that a moderate-to-large earthquake would likely occur along this fault every 500 to 1,000 years (Frazer, Waldrop, and Hyden, 1969, p. 75). The two other nearby faults probably have similar rates of movement. Bear Gulch fault, which cuts through Mineral Hill, is believed to be inactive based on the lack of fresh fault scarps and historic earthquake activity at Jardine.

The Gardiner/Yellowstone Park area is located at the confluence of two zones of higher-than-average earthquake activity. The Intermountain seismic zone extends from Nevada through the Salt Lake/Wasatch Front area, up through Yellowstone, then bends northwestward through Three Forks and Helena, and dies out near Kalispell. This zone is the most active earthquake zone in the U.S. outside of California, Hawaii, Alaska, and Washington.

A second active earthquake zone also converges on Yellowstone Park. The Idaho seismic zone extends from central Idaho eastward into Yellowstone Park, where it ends against the Intermountain seismic belt. Both the Idaho and Intermountain zones of active faulting are probably tied to deep crustal stress within the continent. The presence of near-surface molten magma under Yellowstone Park adds to stress building in the area. Recent ground-elevation measurements by the U.S. Geological Survey indicate that portions of the park have risen inches over a matter of years. Such rapid rates of differential uplift, if continued, could lead to an increase in earthquake activity in the greater Yellowstone region.

HYDROLOGY

Surface Water

The Bear Creek drainage is located in the southwestern portion of the Absaroka range in south-central Montana, and lies within the Gardiner Ranger District of the Gallatin National Forest (see figure II-4). The drainage flows southwest for about eight miles until it reaches the confluence with the Yellowstone River at the western edge of the Black Canyon of the Yellowstone just outside the northern boundary of Yellowstone National Park. The Bear Creek watershed encompasses about 44 square miles and is characterized by steep, deeply incised valleys and high mountain peaks at elevations between 8,000 and 10,000 feet above sea level. The North Fork of Bear Creek drains 12 square miles of the eastern and southwestern slopes of Sheep and Monitor mountains. The main stem of Bear Creek drains about 32 square miles and is augmented by several smaller tributaries, including Darroch, Pine, Pole, and Palmer creeks. Statistics regarding the magnitude and frequency of precipitation events in the Bear Creek drainage are provided in Chapter II--Climate.

Monthly streamflow measurements were used to estimate long-term mean annual discharge, mean monthly discharge, and various points on the flow duration hydrograph using the Riggs' methodology (Riggs, 1968; Parrett, 1985). The long-term mean annual discharge of Bear Creek at Jardine is about 60 cubic feet per second (cfs). Mean monthly discharges range from a low of 12.5 cfs in February to a high of 270 cfs in June. Mean daily discharges for Bear Creek for different exceedance probabilities are presented in figure II-5. Exceedance probabilities are an expression of the percentage of time streamflow equals or exceeds the indicated value. Estimated peak discharges for Bear Creek at Jardine are presented in table II-1 (Westech, 1982).

On December 15, 1978, an order from the Board of Natural Resources and Conservation was signed, establishing minimum streamflows on behalf of the Department of Fish, Wildlife and Parks (Peterman, 1981). The order granted water reservations of the twentieth percentile flow for the months of October through April and for the fiftieth percentile flow May through September. These reservations were established for Bear Creek from the mouth to the confluence with North Fork, and for North Fork until its confluence with Fish Creek (Department of Natural Resources and Conservation, 1979). The availability of flow for future appropriations based on estimated mean monthly flows for Bear Creek is presented in table II-2. The analysis indicates that during an average year there may not be sufficient flow in Bear Creek to satisfy the minimum flow requirement established for fish and wildlife.

Estimates of streamflow and water availability reflect the depletions associated with existing water appropriations. Water from Bear Creek and its tributaries has been used for agricultural, mining, domestic, and stock-watering purposes. Water rights claims for existing uses are summarized in table II-3 (Department of Natural Resources and Conservation, 1985).

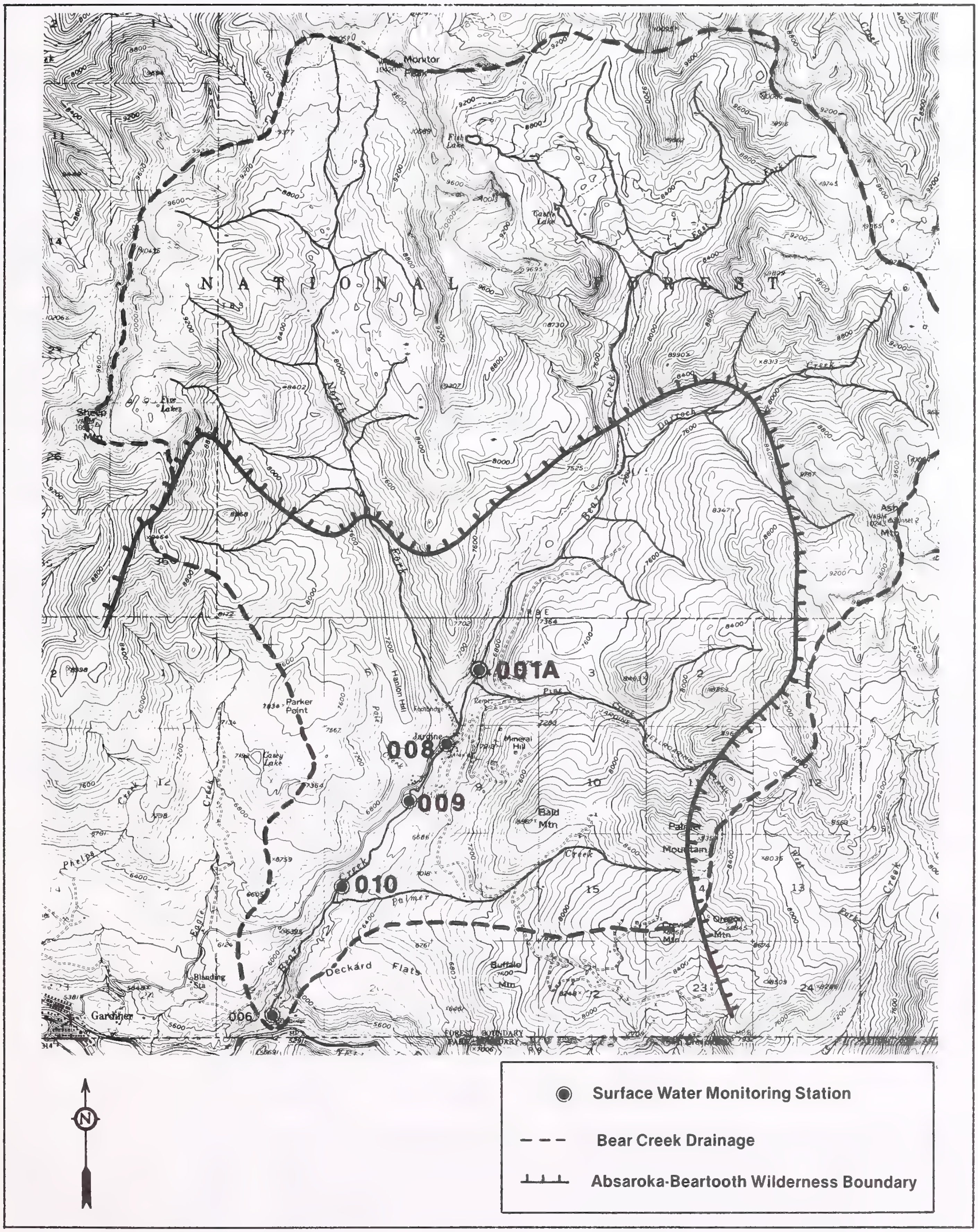


Figure II-4: Several tributaries feed Bear Creek before it joins the Yellowstone River. Surface water monitoring stations provided baseline flow and water quality data.

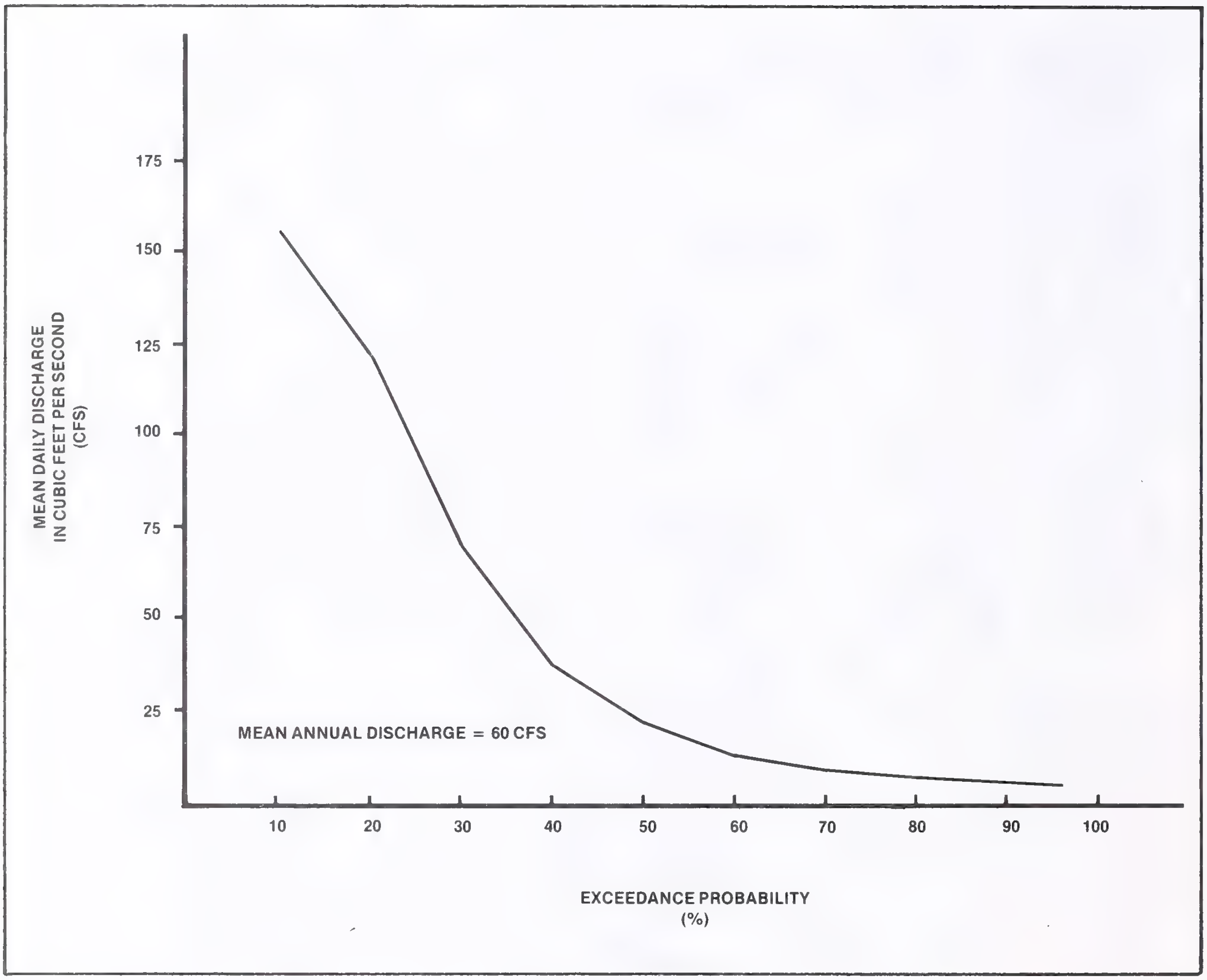


Figure II-5: Flows in Bear Creek are expected to be at least 21 cubic feet per second (cfs) half the time. Higher flows are expected less frequently.

Table II-1: Magnitude and Frequency of Peak Discharge for Bear Creek at Jardine

Recurrence Interval (years)	Flow (cfs)
2	290
5	510
10	670
25	870
50	1,040
100	2,200

Source: Westech, 1982.

Table II-2: Availability of Flow in Bear Creek

Month	Percentile flow requirement[1]	Estimated long-term average discharge[2] (cfs)	Minimum instream requirement[3] (cfs)	Availability (cfs)
October	20%	25.0	18.20	6.80
November	20%	16.0	16.50	-0.50
December	20%	13.0	12.50	0.50
January	20%	13.0	10.10	2.90
February	20%	12.5	9.63	2.87
March	20%	13.0	10.80	2.20
April	20%	18.0	32.30	-14.30
May	50%	125.0	91.10	33.90
June	50%	270.0	290.00	-20.00
July	50%	130.0	120.00	10.00
August	50%	50.0	41.20	8.80
September	50%	35.0	34.50	0.50

[1] Percentile flow or flow exceedance probability is flow that would be equalled or exceeded a certain percentage of the time. The 50-percentile flow is equal to the median flow.

[2] Average standard error of the estimate = 100 percent (U.S. Geological Survey, 1985).

[3] Average standard error of the estimate = 30 percent (U.S. Geological Survey, 1985).

Mean monthly streamflow for the Yellowstone River at the confluence with Bear Creek was estimated to determine the contribution of flow from Bear Creek. These streamflow estimates are presented in table II-4. During periods of snowmelt runoff, Bear Creek contributes only 2.5 percent of the natural flow of the Yellowstone River within the National Park boundary. During winter low flow the contribution is about 1.5 percent.

The headwaters of Bear Creek are located within the Absaroka-Beartooth Wilderness and are classified as A-1 by Montana statutes. The wilderness boundary is delineated on figure II-4. The proposed project is located outside the Absaroka Wilderness where Bear Creek is classified B-1. Waters classified A-1 or B-1 are suitable for drinking, culinary, and processing purposes after conventional treatment. B-1 waters may be used for agricultural and industrial purposes. A-1 and B-1 waters must meet the established water quality standards presented in appendix 10.

Baseline water quality samples were collected and analyzed on a monthly basis for the stations shown in figure II-4 beginning April 1981 for a period of one year. Table II-5 presents the list of parameters that were analyzed. The results of these analyses are provided in table II-6 for the upstream control station (#001), the station adjacent to the project area (#009), and the

Table II-3: Surface Water Rights Claims on Bear Creek Agricultural Uses

Creek	Number of claims	Acres irrigated	Approximate diversion (cfs)*
North Fork	1	5.0	0.14
Bear Creek	6	291.7	8.33
Pole Creek	1	26.0	0.74
Palmer Creek	1	55.0	1.57
TOTAL	9	377.7	10.78

*estimated (2 cfs per 70 acres)

Domestic Uses

Creek	Households served
Bear Creek	4
Palmer Creek	5

Mining Uses

Number of claims	Total diversions
(Homestake) 25	201.6 cfs
(Other) 19	27.9 cfs

Stock Watering Uses

Number of claims	Total number of head
9	732

Source: Department of Natural Resources and Conservation, 1985.

station at the confluence of Bear Creek and the Yellowstone River (#006). Water samples were characterized using criteria established by the U.S. Environmental Protection Agency (EPA, 1976) and the Montana Department of Health and Environmental Sciences (DHES, 1984). Quality criteria for aquatic life, public water supplies, recreation, irrigation, and livestock are presented in table II-7 (U.S. Environmental Protection Agency, 1976; DHES, 1984).

Table II-4: Average Monthly Discharges in Cubic Feet Per Second for Various Locations in the Yellowstone River Basin

Month	Yellowstone River at Corwin Springs, Montana (Gage #06191500)	Gardner River near Mammoth, Wyoming (Gage #0619100)	Yellowstone River at confluence with Bear Creek*
October	1,530	127	1,403
November	1,190	111	1,079
December	967	101	866
January	841	95	746
February	828	91	737
March	905	90	815
April	1,460	128	1,332
May	5,780	489	5,291
June	11,500	770	10,730
July	7,020	327	6,693
August	3,270	166	3,104
September	2,000	139	1,861

Source: United States Geological Survey, 1982.

*Values estimated based on flow at Corwin Springs adjusted for inflow from the Gardner River. Estimated flow values may be somewhat larger than actual values.

The results of the water quality analyses indicate that the waters of Bear Creek are calcium-carbonate type with low hardness. Total and dissolved metals are below the established criteria for all uses except for total manganese and iron, which occasionally exceed recommended drinking water standards downstream of Jardine. The pH varies seasonally between 7.2 and 8.6.

During the sampling period, total suspended solids (TSS) in the main stem of Bear Creek was found in concentrations between 1 and 36 milligrams per liter (mg/l) with the highest concentrations adjacent to the disturbed area near Jardine during spring runoff. Natural sediment yield to Bear Creek at the mouth was estimated to be about 550 tons per year (U.S.D.A. Forest Service, 1981). During the sampling period, disturbances associated with existing roads and historic mining activities contributed about 650 more tons per year. Concentrations of TSS are expected to vary from year to year and depend on the magnitude and frequency of precipitation and flood events.

Arsenic loading to Bear Creek increases below Jardine and appears to be highest during low-flow periods. Concentrations of arsenic vary from less than 0.005 mg/l at the upstream control station to 0.032 mg/l at the confluence with the Yellowstone River. The presence of arsenic in Bear Creek is attributable, in part, to wastes and seeps associated with the old ore processing site, existing tailings impoundments, and various dumps. On April 20, 1983, the Department of Health and Environmental Sciences (DHES) sampled seeps from the existing small tailings impoundment adjacent to Bear Creek. Results

Table II-5: Parameters for Baseline Water Quality Assessment of Bear Creek

Alkalinity	Total ammonia	Aluminum
Acidity	Total nitrate	Arsenic
Conductivity	Oil and grease	Boron
Dissolved Oxygen	Orthophosphate	Cadmium
Hardness (as $CaCO_3$)		Chromium
pH	Bicarbonate	Copper
Temperature	Calcium	Iron
Total dissolved solids	Carbonate	Lead
Total suspended sediment	Chloride	Manganese
Turbidity	Fluoride	Mercury
	Magnesium	Selenium
Cyanide	Potassium	Vanadium
	Sodium	Zinc
	Sulfate	

Source: Project application, 1984.

of this analysis indicated elevated concentrations of arsenic (0.087 mg/l), cadmium (0.015 mg/l), cobalt (0.024 mg/l), nickel (0.107 mg/l), manganese (0.856 mg/l), iron (3.342 mg/l), and aluminum (2.444 mg/l). In addition, a special water analysis by Westech in January 1981 indicated there were about 0.047 milligrams per liter of arsenic in Bear Creek below the existing small tailings impoundment in Jardine. Evidence of water quality degradation (rock stains) from these tailings is present up to one-quarter of a mile downstream (Larry Brown, DHES, pers. comm., March 3, 1985).

Although the concentration of arsenic in Bear Creek may be elevated due to past mining activities, the contribution of arsenic to the mainstem Yellowstone River is insignificant. In addition to the fact that Bear Creek provides only 1.5 percent to 2.5 percent of the flow of the Yellowstone River, the U.S. Geological Survey (USGS) has documented that natural levels of arsenic in the Yellowstone mainstem range between 0.005 and 0.024 mg/l. The USGS reports that natural sources from thermal activity within and near Yellowstone National Park are responsible for elevated arsenic levels (USGS, 1983).

Bear Creek was sampled by Westech for cyanide once during spring high runoff in June, 1981; no cyanide was detected. The USGS indicates that cyanide has never been detected in the Yellowstone River (USGS, 1971).

Ground Water

The foundation materials at the site of the proposed tailings dump consist of Quarternary sediments overlying Precambrian metamorphic rocks.

Drilling of monitoring wells in the proposed tailings area by Westech shows bedrock to be as much as 300 feet below the surface of the terrace deposits, or about 50 feet below the level of Bear Creek (Steffen Robertson and Kirsten, 1984).

Glacial tills cover bedrock on most of the surrounding hillsides and are the oldest deposits at the site. Sediments overlying the till in the area of the proposed impoundment consist of two sequences. The lower sequence is one of bedded clays, silts, and fine sands. Above the fine-grained sediment is about 100 feet of coarse-grained sands and gravels.

The water table appears to coincide with the intersection of the coarser- and finer-grained sediments at a depth of about 100 to 150 feet. Perched water is also found above layers of silts and clays and is most likely associated with seepage from the historic tailings impoundment (Steffen Robertson and Kirsten, 1984). A simplified cross section through the proposed tailings site was presented in figure II-3.

The movement of water in the project area is downgradient from Mineral Hill towards Bear Creek at about 0.25 feet per foot through bedrock and 0.10 feet per foot through glacial deposits (project application, 1984). Bedrock hydraulic conductivity is assumed to be 1×10^{-4} feet per day. Hydraulic conductivities in the assorted glacial deposits range between 1×10^{3} feet per day in clean sands and gravels to 1×10^{-3} feet per day in silts and clays, or mixtures of sand, silt, and clay (U.S.D.I. Bureau of Reclamation, 1977). Assuming an effective porosity of 0.45 in fractured bedrock (USGS, 1967), and 0.20 in sands and gravels, it has been estimated that ground water flows through bedrock in Mineral Hill at about 5.6×10^{-5} feet per day and up to 500 feet per day in Bear Creek alluvium.

Analysis of the ground water system suggests there is a hydraulic connection between the bedrock aquifer below the proposed mine workings and the alluvial deposits in the vicinity of Bear Creek (project application, 1984). Although percolation through the existing mines is probably greatest during snowmelt periods, the contribution of water from bedrock to the alluvial system is considered to be small (Darrel Dunn, consulting geologist, pers. comm., 1985).

Claims for existing uses of ground water filed with the Montana Department of Natural Resources and Conservation (DNRC) are summarized in table II-8. The applicant has filed water rights claims for 224 gallons per minute of ground water in township 9 south, range 9 east, section 9 for mining purposes; the priority date claimed is 1898.

Ground water samples were analyzed from seven wells located near the proposed tailings dump site, one well near the proposed mill site, and one well downgradient of the existing tailings site near the Jardine bridge. Water samples have been collected quarterly since July 1984. Well locations are identified in figure II-6.

Table II-6: Results of Bear Creek Water Quality Analyses for Indicated Sampling Stations (concentrations in milligrams per liter)

Parameter	Criteria	Jan	Feb	Mar	Apr	May		Jun		Jul	Aug	Sep	Oct	Nov	Dec
Site 001 - Upstream Control Site															
Flow (cfs)		9	7	6	7	77	60	173	92	70	25	11	9	6	-
pH	6.5-8.5	7.5	7.9	7.6	7.4	7.2	7.3	7.5	7.9	8.3	7.9	7.9	7.1	8.2	8.11
TDS	250 mg/l	57	36	45	39	51	126	31	20	35	42	51	59	42	45
TSS	narrative	3	1	4	1	4	2	12	1	4	1	3	5	8	2
As	0.00 mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cn	0.0052 mg/l							<0.005							
Fe	0.3 mg/l	00.03	<0.03	<0.03	<0.03	0.11	0.06	0.07	0.05	<0.03	0.03	<0.03	<0.03	<0.03	<0.03
Mn	0.05 mg/l							<0.02			<0.02				
SO_4	250	3	3	3	2	2	2	2	2	1	2	3	3	2	1
NO_x	10 mg/l	0.12	0.08	0.15	<0.05	<0.05	<0.05	<0.05	0.06	0.06	<0.05	<0.05	<0.05	<0.05	<0.05
$NH_3 + NH_4$		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	0.14	<0.10	0.07	<0.10
P (ortho)		0.03	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	0.04
Site 009 - Adjacent to Proposed Project															
Flow (cfs)		-	-	-	11	-	-	216	162	-	-	-	-	-	-
pH	6.5-8.5	7.8	8.0	8.0	7.2	8.1	7.9	7.7	7.6	7.9	8.1	8.1	7.8	8.25	8.1
TDS	250 mg/l	64	47	64	57	62	60	36	35	32	59	64	86	69	
TSS	narrative	1	1	32	36	14	5	11	3	6	-	6	3	10	4
As	0.00 mg/l	0.015	0.013	0.02	0.018	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.012	0.008	0.012	0.013
Cn	0.0052 mg/l							<0.005							
Fe	0.3 mg/l	0.09	0.07	0.09	0.04	0.12	0.06	0.11	0.08	<0.03	0.04	0.11	0.07	0.05	0.06
Mn	0.05 mg/l							<0.01			<0.02				
SO_4	250	7	7	5	6	3	3	2	2	2	4	7	7	7	
NO_x	10 mg/l	0.05	0.11	0.08	0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	0.05	<0.05	0.05
$NH_3 + NH_4$		0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	<0.10	0.24	0.18
P (ortho)		0.02	0.01	0.02	0.03	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	0.01	0.03

Site 006 - At Mouth of Bear Creek

Flow (cfs)		9	7	14	14	82	97	194	145	89	17	11	8	11	-
pH	6.5-8.5	7.9	8.4	7.8	7.8	7.6	7.2	8.0	7.7	7.4	8.0	8.3	8.2	8.2	7.8
TDS	250 mg/l	113	98	102	90	64	86	37	23	38	98	127	155	124	90
TSS	narrative	1	2	2	13	13	7	1	1	7	1	3	5	6	4
As	0.00 mg/l	0.021	0.019	0.024	0.032	0.007	<0.005	<0.005	<0.005	0.008	0.014	0.027	0.019	0.022	0.022
Cn	0.0052 mg/l							<0.005							
Fe	0.3 mg/l	0.03	0.03	<0.03	<0.03	0.12	0.09	0.11	0.07	<0.03	0.03	<0.03	<0.03	0.04	<0.03
Mn	0.05 mg/l							<0.02			<0.02				
SO_4	250	22	22	18	17	5	4	3	3	5	15	23	32	26	20
NO_x	10 mg/l	0.12	0.18	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05
$NH_3 + NH_4$		0.10	0.10	0.12	<0.10	0.20	0.10	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	0.27	<0.10
P (ortho)		0.02	0.01	0.05	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.03

Source: Project application, 1984.

*Metals concentration represents dissolved fraction only.

**Samples taken between April 1981 and March 1982.

Table II-7: Water Quality Criteria Matrix (milligrams per liter unless otherwise noted)

	Cold water aquatic life (mg/l)	Public water supplies (mg/l)	Primary contact recreation (mg/l)	Irrigation (mg/l)	Livestock watering (mg/l)
Dissolved oxygen	7.0				
Fecal coliforms (per 100 ml)			200.0	1000.0	
Nitrite as N	0.05	1.0			10.0
Nitrate as N		10.0			
Nitrite and nitrate as N		10.0			100.0
Total ammonia		0.5			
Un-ionized ammonia	0.03				
Total inorganic N	1.00				
Total phosphorus	0.10		0.10		
Total dissolved solids		500.0		1200.0	10,000.0
Conductance (mircomhos/cm)				1800.0	
Turbidity (NTU)	10.0				
Total suspended solids	30.0				
Chloride		250.0		700.0	
Sulfate		250.0			
Cyanide	0.0052	0.2			
Magnesium				160.0	
Sodium				160.0	
Sodium adsorption ratio				5.0	
Fluoride		2.4		15.0	2.0
Arsenic	0.44	0.00		0.10	0.20
Barium		1.00			
Boron				0.75	5.00
Chromium VI	0.021	0.05		1.00	
Iron	1.0	0.3		20.0	
Manganese		0.05		10.0	
Selenium	0.26	0.01		0.02	0.05
Mercury	0.004	0.002			0.010
Temperature (C)	19.4				
Temperature (F)	67.0				
Copper	**	1.0		5.0	0.5
Lead	**	0.05		10.0	0.10
Zinc	**	5.0		10.0	25.0
Cadmium	**	0.01		0.05	0.05
Chromium III	**	17.8			
Nickel	**	0.015		2.0	
Silver	**	0.05			
pH (minimum)	6.5	6.5	6.5	4.5	
pH (maximum)	8.5	8.5	8.5	9.0	

Source: Montana Department of Health and Environmental Sciences, 1984.
**Specific criteria for the protection of aquatic life are based on water hardness.

Table II-8: Existing Ground Water Claims in Bear Creek Basin

Current owner	Location of well	Maximum flow rate	Remarks
U.S. Forest Service	T9S-R9E-S4	45 gpm	Upgradient of project
Denise L. Harms	T9S-R9E-S8	12 gpm	
Oliver Wormsbecker	T9S-R9E-S8	40 gpm	Unaffected by project
George and Viola Athias	T9S-R9E-S8	16 gpm	Unaffected by project
Louise Foster	T9S-R9E-S9	20 gpm	
Homestake Mining Company	T9S-R9E-S9	224 gpm	Priority date--1898 Use--mining
Crevasse Mountain Mining Company	T9S-R9E-S11	666 gpm	Use--mining
Crevasse Mountain Mining Company	T9S-R9E-S22	1,571 gpm	Use--mining
Raymond Opperman	T9S-R9E-S11	10 gpm	
Richard Blankenship	T9S-R9E-S22	5 gpm	Unaffected by project

Source: Montana Department of Natural Resources and Conservation, 1985.

Ground water quality in the project area is calcium carbonate type with values of pH ranging from 6.8 to 7.8. Concentrations of heavy metals, arsenic, and cyanide appear elevated. Table II-9 presents selected ground water quality data that characterize the impact that past mining activities have had on the quality of water near the existing small tailings impoundment. Poor-quality water from the alluvial aquifer enters Bear Creek and is eventually diluted.

AQUATICS

Aquatic macroinvertebrates and algae were collected at seven sites (figure II-7) in April (before spring runoff), August (after spring runoff), and November (during fall low flow) of 1981. The aquatic biota in Bear Creek are indicative of good-quality surface waters.

Macroinvertebrate

Insects were collected using the unit-effort-traveling-kick method. More than 90 percent of the total insect population at all stations consisted of stoneflies (Plecoptera), mayflies (Ephemeroptera), and caddisflies (Tricoptera). Fifty-nine individual taxa were identified, 28 of which were common to all 7 sampling sites. The number of taxa collected ranged from 29 at Pine Creek to 41 at North Fork Bear Creek. The sites on Bear Creek showed little variation in total number of taxa. Mean organism numbers per sample ranged from 290 organisms at site 008 to 175 organisms at site 001. The mayfly Rhithrogena robusta and stoneflies of the family Chloroperidae were the

Table II-9: Maximum Recorded Concentrations of Selected Ground Water Quality Constituents

	EPA criteria (mg/l)	At proposed tailings site	At proposed mill site	Downgradient of old tailings*
Cyanide	0.2	0.136(T)	0.006(T)	**
Arsenic	0.00	0.13	0.081	130.0(T)
Manganese	0.05	0.63	0.58	4.93(T)
Iron	0.3	0.80	0.28	740.0(T)
Lead	0.05	0.01	0.02	0.13(T)
Mercury	0.002	<0.001	<0.001	0.026(T)

Source: Project application, 1984.
All concentrations represent dissolved fraction unless otherwise indicated.
(T) = Total
*Special water analysis by Western Technology on January 27, 1981.
** No sample taken.

predominant organisms at all sampling stations. Relative abundance of taxa collected at each site is listed in appendix 2.

Unpolluted streams with favorable substrate, oxygen levels, and temperature generally produce a minimum of 15 genera depending on stream order and season of collection (DHES, 1981). Aquatic numbers in Bear Creek indicate unpolluted conditions despite the apparent contributions of sediment and metals from past mining activities.

Leeches (Hirudinea) were the only other macroinvertebrates collected; they were common at all sites.

Periphyton

Periphytic algae were collected from natural substrates at the same seven sites (figure II-7). As a water quality indicator, the diatoms (Bacillariophyta) are quite important. Bahls (1979) found that benthic diatom associations in unpolluted Montana streams usually had more than 25 species and a Shannon Weaver diversity index (Weber, 1973) greater than three. Total average diatom species present ranged from 36 (station 002) to 47 (station 009); average diversity indexes ranged from 3.85 (station 010) to 4.54 (station 009). Thus, Bear Creek provides good quality habitat for aquatic life. Some of the more abundant diatom species were Fragilaria vaucheriae, Cocconeis placentula, and Rhoicosphenia curvata. A complete species listing and percent relative abundance table is available at the Montana Department of State Lands (project application, 1984).

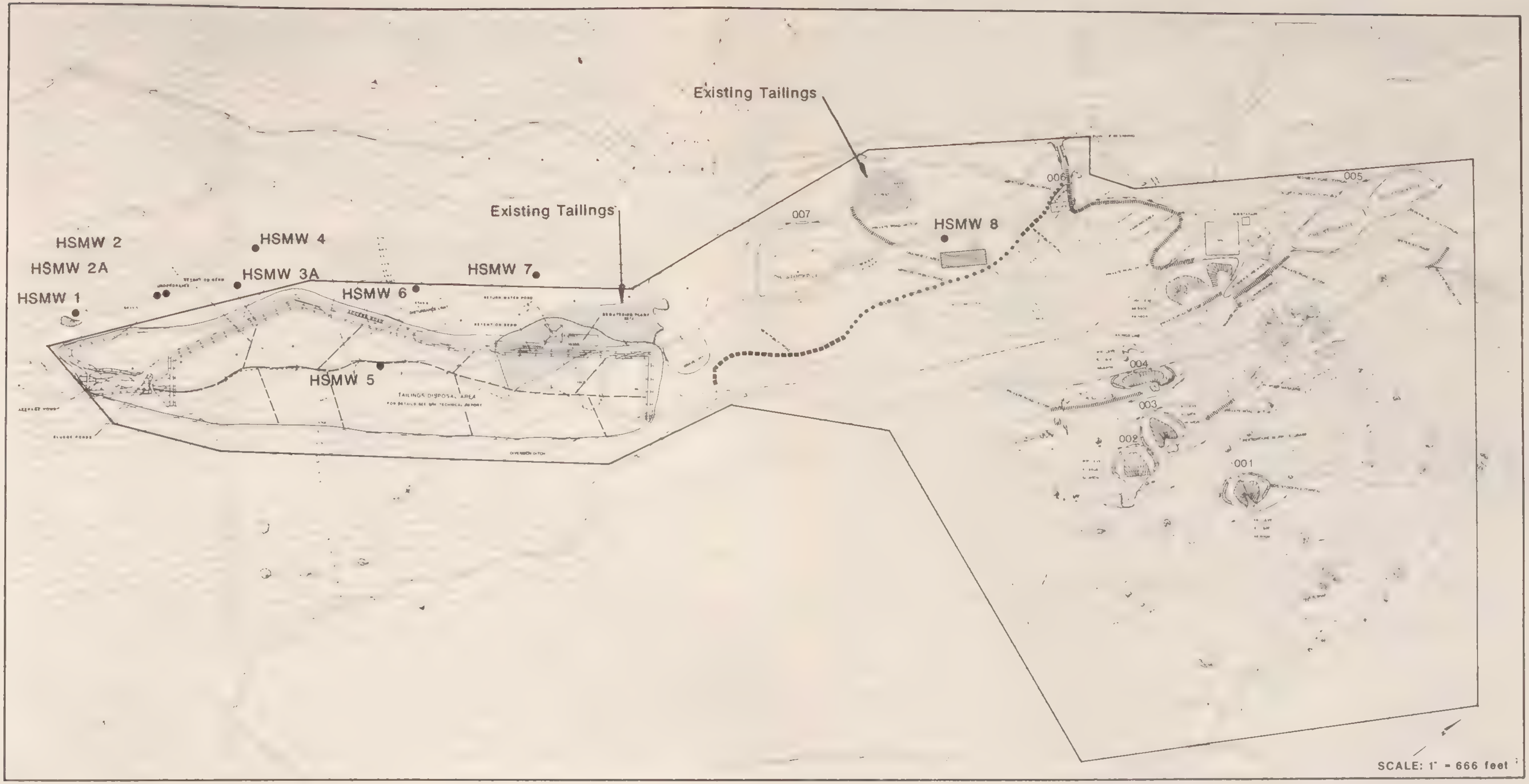


Figure II-6: Groundwater water samples were analyzed from seven wells. These wells would monitor the water quality in the aquifer below the proposed tailings dump

HSMW 1 ● Monitoring Well Location

▨ Existing Tailings

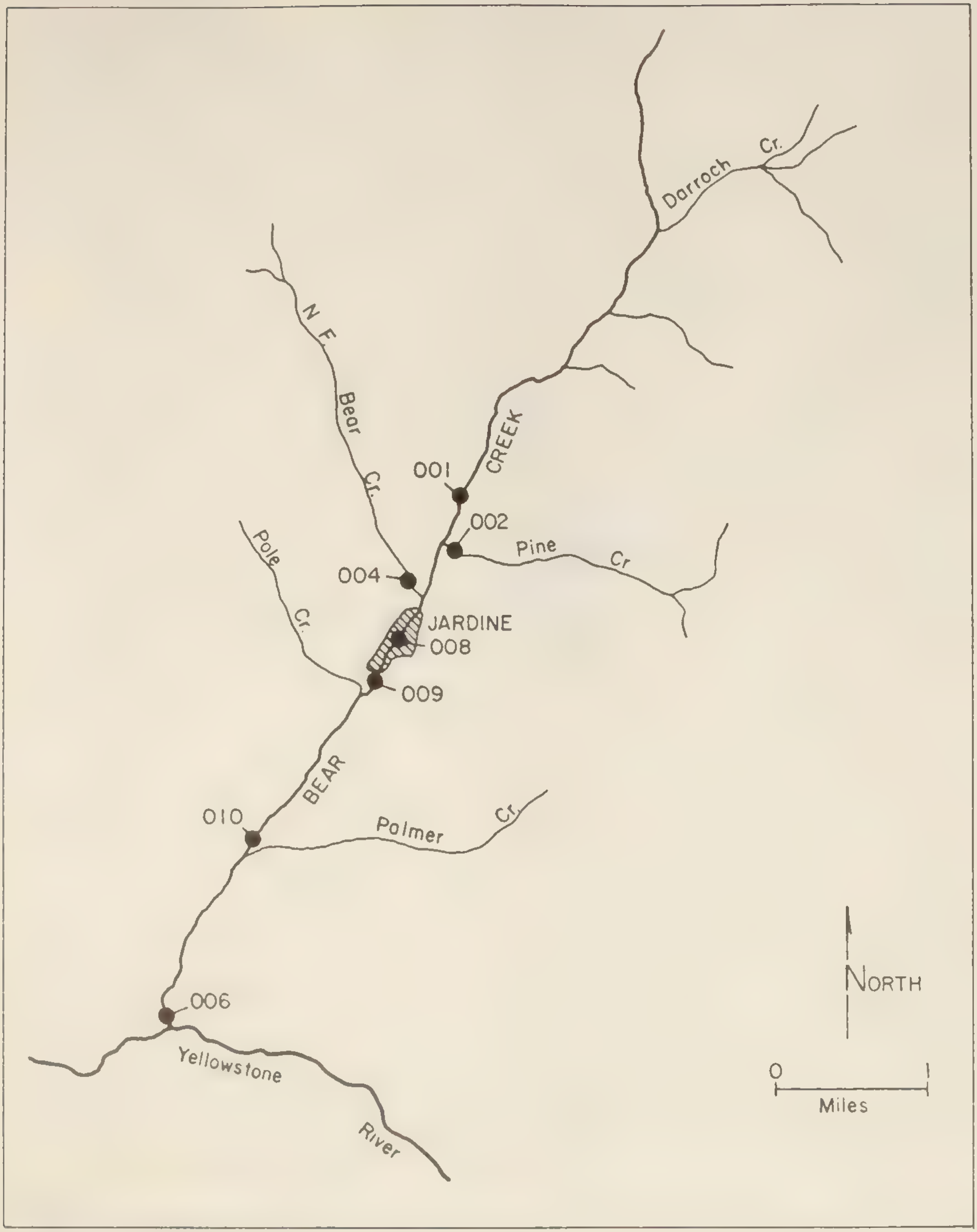


Figure II-7: Aquatic macroinvertebrates and algae were collected at seven sites in April, August, and November of 1981.

In addition to the diatoms, 15 genera of green algae (Chlorophyta), 10 genera of blue-green algae (Cyanophyta), four genera of yellow-green algae (Chrysophyta), and two genera of red algae (Rhodophyta) were collected.

Aquatic Macrophytes

No aquatic macrophytes (higher plants) were observed during the survey. The habitat is not conducive to their survival because Bear Creek is a low-order, cascading stream with few pools and a coarse gravel, cobble, and boulder substrate.

FISHERIES

Bear Creek supports a relatively diverse and abundant sport fishery. The fishery contains mostly of rainbow trout x cutthroat trout hybrids, and pure Yellowstone cutthroat trout. Rainbow trout, brown trout, and mountain whitefish are less abundant. No nongame species were captured or observed.

Fish populations were sampled with a bank electrofishing unit (Oswald *in*: project application, 1984) at three primary sites on Bear Creek. Five species of game fish were caught: cutthroat trout (*Salmo clarki*), rainbow trout (*Salmo gairdneri*), rainbow x cutthroat hybrids (*S. gairdneri* x *S. clarki*), brown trout (*Salmo trutta*), and mountain whitefish (*Prosopium williamsoni*).

Bear Creek supports both migrant and resident populations of cutthroat trout. Migrating cutthroat trout were captured only at the Powerhouse section (figure II-8) and the migration appears to have peaked during early July. Spawning occurred between July 9 and July 22, 1981. Although only 19 migrants were captured, this total is greater than that captured in eight of the nine tributaries studied by Berg (1975) for three years. Only Cedar Creek, with 20 fish per year, had a greater total. Thus, lower Bear Creek appears to support substantial cutthroat spawning migration in relation to other nearby Yellowstone tributaries (Oswald *in*: project application, 1984).

Resident cutthroat trout were captured in all sampling sections of Bear Creek, but most often in the upstream trail section. These resident cutthroat trout were the pure Yellowstone strain, a species of "special concern" determined by the Montana Department of Fish, Wildlife, and Parks. Although this designation has no legal implications, it does indicate concern for the future of the species within its Montana distribution.

Rainbow x cutthroat hybrids were more abundant than resident cutthroat trout at all sampling sites. The measured density of rainbow x cutthroat hybrids ranged from 65-151 per 1,000 feet (total biomass of 8-27 pounds per 1,000 feet) compared to the highest density of cutthroat trout of 42 per 1,000 feet (total biomass nine pounds per 1,000 feet). These hybrids may have originated when Bear Creek was stocked with 2,050 catchable rainbow trout in 1958.

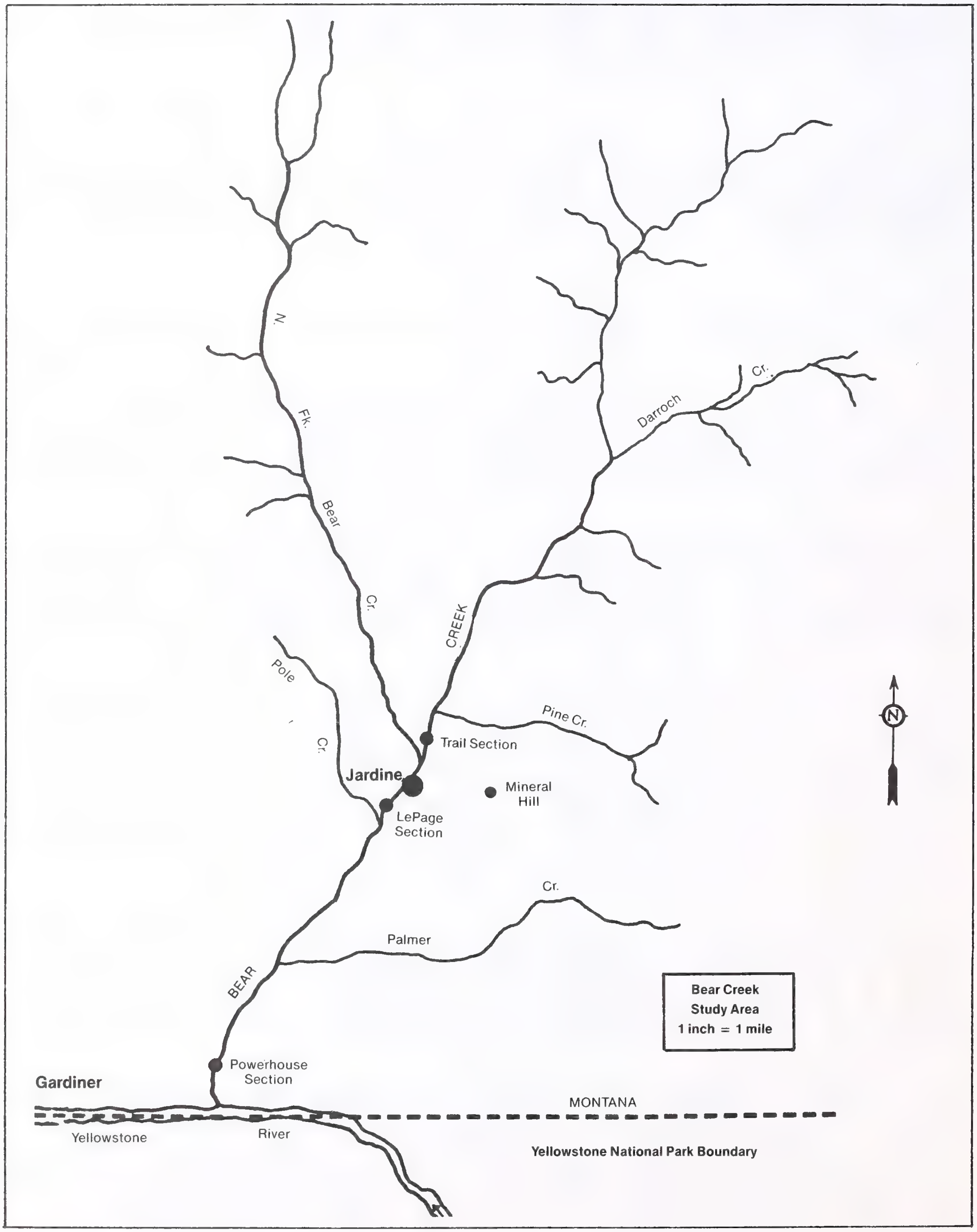


Figure II-8: Fish populations were sampled with a bank electrofishing unit at three primary sites on Bear Creek.

Rainbow trout were collected infrequently at all sampling areas; brown trout and mountain whitefish were collected in small numbers only at the Powerhouse section. No migrating brown trout were collected. If mountain whitefish spawned in Bear Creek, their migration was limited to the extreme lower portion of the stream.

Numbers of game fish per 1,000 feet of stream increased downstream. However, the greatest biomass of fish was in the LePage section, immediately downstream from Jardine. Perhaps this increase is due to higher productivity of Bear Creek caused by nutrient loading from septic systems or limited fishing pressure on the private land adjacent to this section of stream.

SOILS

The Jardine Joint Venture soil survey covers about 2,500 acres in and around the town of Jardine. This area includes the 410-acre proposed permit area and the 93-acre proposed disturbance area.

The soils of the proposed permit area vary widely in depth, color, profile morphology, drainage characteristics, organic matter content, and trace element concentrations. This diversity reflects the variability of topography, parent materials, vegetation, past land use practices, and disturbances. In general, the soils are naturally acidic, coarse textured (with few exceptions), and frequently have a coarse fragment content (gravels or cobbles) greater than 25 percent by volume.

Within the proposed permit area, a total of 10 soil series (including phases) have been identified and placed into 10 mapping units. (The soils in this survey were named using letters of the alphabet to avoid any potential conflict with official Soil Conservation Service soil series names.) In addition, a "disturbed" mapping unit was used to identify areas where the natural soils have been disturbed by past mining and other related activities. For ease of discussion, the soil mapping units have been placed into four major soil groups, based on similarities in parent material and, to some extent, topographical position:

--alluvial soils

--colluvial soils

--glacial soils

--alluvial/glacial soils

The location of these soil groups within the proposed permit area is shown in figure II-9. For a complete list of the mapping units proposed for disturbance, as well as the amount of soil by unit proposed for salvage, see Chapter III--Soils, table III-6.

Alluvial Soils

The alluvial soils group covers about 26 percent of the proposed permit area and about half of the proposed disturbance area. The group includes both shallow and deep soils that developed in alluvium (water-deposited material).

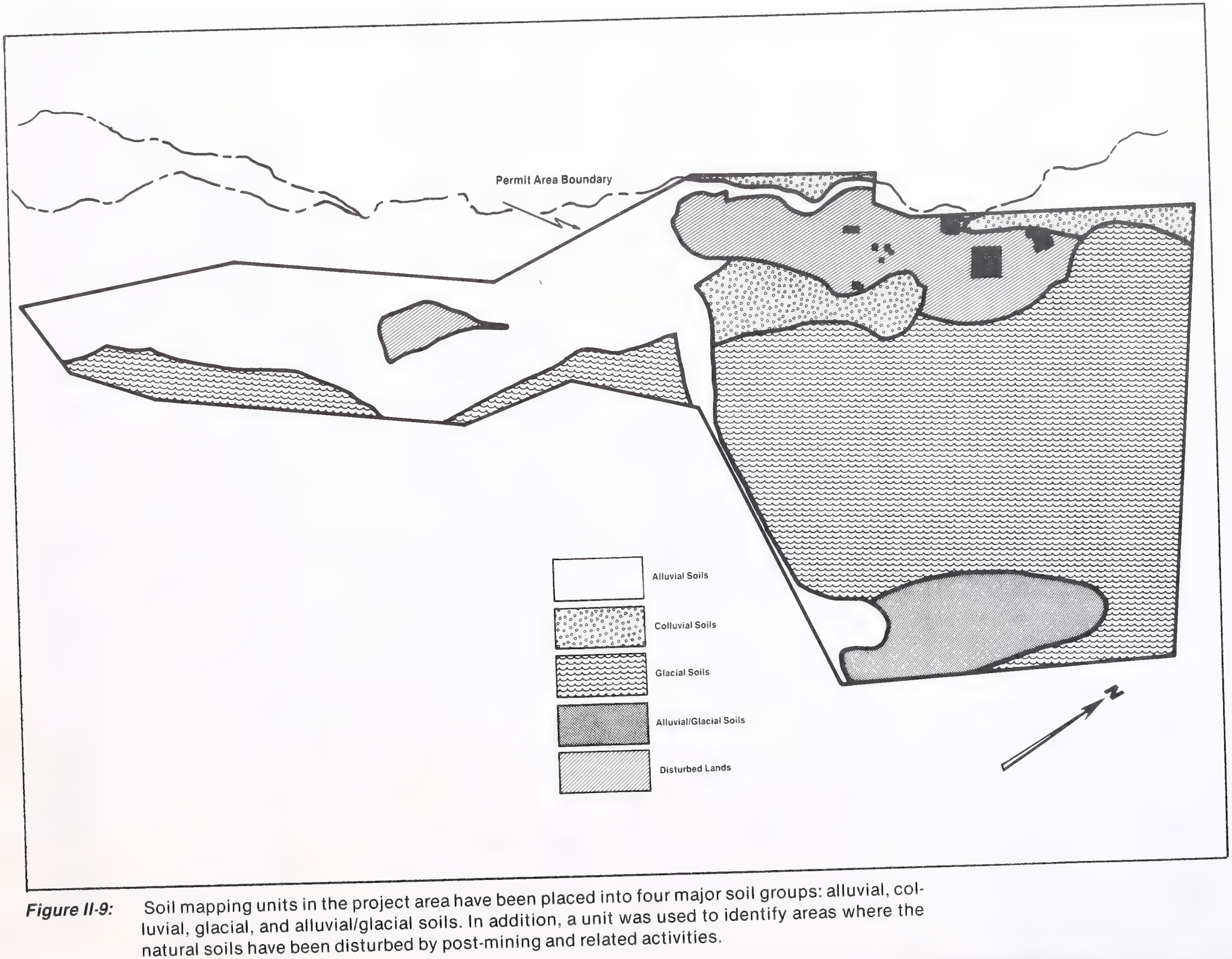


Figure II-9: Soil mapping units in the project area have been placed into four major soil groups: alluvial, colluvial, glacial, and alluvial/glacial soils. In addition, a unit was used to identify areas where the natural soils have been disturbed by post-mining and related activities.

The soils in this group vary somewhat in physical and chemical characteristics and degree of soil development. The individual soil characteristics are determined largely by the original source of the water-deposited materials, the degree to which these materials were sorted, and the local microenvironment in which the soils developed.

Type B and Est soils are the shallow soils in this group; type E and M soils are deep. The predominant soil texture in the group is gravelly sandy loam; however, textures range from loam to gravelly sand. The coarse fragment content ranges from 14 to 73 percent by volume and generally increases with depth. The pH of these soils ranges from 5.0 (strongly acid) to 6.7 (near neutral). Trace element concentrations are generally within acceptable ranges, although aluminum and arsenic levels are elevated in some soil horizons within this group.

Most of the alluvial soils are found along the west side of the permit area, with the remainder occurring in an east-west drainage on the southwest side of Mineral Hill. Plant species commonly associated with this soils group include Engelmann spruce, Douglas-fir, big sagebrush, Idaho fescue, bluebunch wheatgrass, twinflower, sweet-scented bedstraw, starry Solomon's seal, arrowleaf balsamroot, lupine, and sticky geranium.

Colluvial Soils

The colluvial soils group consists of only one soil type--the S series--which occurs in three segments in the northwest part of the permit area (figure II-9). This soil covers about 6 percent of the proposed permit area and about 2 percent of the proposed disturbance area. The S soil is a shallow, very gravelly, sandy loam soil that formed in colluvium--material that has moved downhill and accumulated at the base of steep slopes as a result of gravity.

The coarse fragment content of the S soil ranges between 20 and 40 percent by volume, and increases with depth. The pH of this soil ranges from 5.1 (strongly acid) to 5.8 (medium acid). Trace element concentrations are within acceptable ranges with the exception of aluminum, which is elevated in all samples. The most common vegetation on this soil is Douglas-fir, Idaho fescue, bluebunch wheatgrass, big sagebrush, milkvetch, and phlox.

Glacial Soils

Glacial soils cover about half of the proposed permit area and about 17 percent of the disturbance area. This group is located in the northern and eastern sections of the permit area (figure II-9). The group consists of moderately deep to deep soils that formed in glacial till (unstratified material deposited by glaciers).

Included in this group are the A, A1, and F soils. Soil textures range from gravelly loams to very gravelly sandy loams. The A and F soils range between 25 and 60 percent coarse fragments; the A1 soils generally have less fragments, with a range between 15 and 20 percent. As with the other soil groups, coarse fragment content increases with depth. The pH of the soils in this group ranges from 4.7 (very strongly acid) to 7.9 (moderately alkaline). Trace element concentrations are low, with the exception of elevated aluminum in one sample of the F soil. Vegetation associated with these soils at lower elevations includes Douglas-fir, pinegrass, common snowberry, big sagebrush, Idaho fescue, and bluebunch wheatgrass. At higher elevations, the vegetation includes subalpine fir, Engelmann spruce, lodgepole pine, whitebark pine, twinflower, arnica, and aster.

Alluvial/Glacial Soils

The alluvial/glacial soils formed in alluvium deposited over glacial till. This soils group consists of deep soils and covers about 6 percent of the permit area. Although this group is found in the permit area, it would not be disturbed by the proposed operation. The group consists of the D and G soils, which are located to the south and east of the summit of Mineral Hill (figure II-9). The soils in this group are poorly drained, which indicates that they have a water table near the soil surface. Soil textures vary from cobbly and fine gravelly loams to silt loams. Coarse fragment content ranges from less than 10 to 40 percent by volume, and increases with depth. The pH range of these soils is between 5.0 (strongly acid) and 6.7 (near neutral). With the exception of aluminum levels elevated in two samples of the G soil, trace element concentrations are low.

Plant species associated with this soils group include timothy grass, sedges, strawberry, larkspur, lupine, prairie smoke, and sticky geranium in the wetter areas; the drier areas include big sagebrush, Idaho fescue, and bluebunch wheatgrass along with a moderate forb cover.

Disturbed Area

Disturbed areas occupy about 11 percent of the proposed permit area and about 28 percent of the proposed disturbance area. This mapping unit was used to map such areas as roads, old tailings ponds, the old mill and other facility areas, and the disturbances within the Jardine townsite (houses, barns, corrals, pastures, etc.). Within this disturbance area are some soils that may be suitable for salvage, but occur in such small areas that they could not be individually delineated on the map. Some of these soils may be high in trace-element concentrations because they are near disturbed areas.

VEGETATION

The 1,514-acre vegetation study area included the proposed permit area. Eleven vegetation types were identified during 1981 baseline surveys (Westech, 1982). The big sagebrush/Idaho fescue, big sagebrush/Douglas-fir, and Douglas-fir/common snowberry types make up 84 percent of the study area (table II-10). (See appendix 5 for scientific names.)

Table II-10: Vegetation Types and Number of Species in the Jardine Vegetation Study Area, May-August, 1981

	Vegetation type	No. of species recorded	No. of sampling transects	Study area		Disturbance area	
				acres	percent	acres	percent
(1)	Idaho fescue/bluebunch wheatgrass	63	5	9	1	0	0
(2)	Big sagebrush/Idaho fescue	90	7	489	32	39	42
(3)	Burned big sagebrush	53	3	9	1	0	0
(4)	Big sagebrush/Douglas-fir	77	5	421	28	19	20
(5)	Douglas-fir/common snowberry	80	8	368	24	9	10
(6)	Douglas-fir/pinegrass	53	3	40	3	-	-
(7)	Engelmann spruce	27[2]	4	47	3	-	-
(8)	Subalpine fir	33[2]	5	-[1]	-	0	0
(9)	Quaking aspen	75	5	45	3	0	0
(10)	Disturbance	0	0	67	4	26	28
(11)	Pasture	0	0	19	1	0	0
	TOTAL	326[3]	45	1,514	100	93	100

Source: Westech, 1982.

[1] Less than 1 percent or 1 acre.

[2] Determined by averaging subtypes (see text).

[3] The same species were often recorded in more than one type, therefore, the column does not total 326 (see text).

A total of 326 plant species were identified during the field study. The greatest number of species was found in the big sagebrush/Idaho fescue vegetation type (table II-10). No threatened or endangered plant species (Ayensu and DeFillips, 1978) or rare plants (Lesica et al., 1984) were discovered in the study area.

Based on Soil Conservation Service methods (1977, 1981), most rangeland--nonforested and undisturbed areas--in the study area is in good condition (50 to 75 percent of climax). However, livestock grazing is prohibited on the national forest lands that constitute over half of the study area. The only grazing lands that would be affected by mining are horse pastures within the proposed permit area (project application, 1984).

Descriptions of Vegetation Types

(1) Idaho fescue/bluebunch wheatgrass. Idaho fescue, constituting 21 percent of the vegetation cover, is the dominant grass in this type. Bluebunch wheatgrass and prairie junegrass are the other common grasses. Perennial grasses

account for 57 percent of total annual production (table II-11). Forbs make up 30 percent of the vegetation cover with silky lupine, many-flowered phlox, and rose pussytoes occurring most often. Shrubs, primarily big sagebrush and green rabbitbrush, also contribute to the vegetational composition (table II-12).

(2) Big sagebrush/Idaho fescue. The dominant understory plant in this type is Idaho fescue. Bluebunch wheatgrass and prairie junegrass are commonly found. Forbs, notably arrowleaf balsamroot, weedy milkvetch, and thickstem aster, are intermixed with the grasses. Total production is estimated at 1,138 pounds/acre/year. The shrub overstory is almost entirely big sagebrush.

(3) Burned big sagebrush. Prescribed burning from 1976 through 1978 stimulated the growth of perennial grasses in areas formerly dominated by sagebrush. Total grass cover is 73 percent, much higher than the 43 percent cover reported for the Idaho fescue/bluebunch wheatgrass type. Production also responded positively to burning. Burned areas have 2-1/2 times the herbaceous production of unburned big sagebrush/Idaho fescue type. The most abundant grass is Columbia needlegrass. Bluebunch wheatgrass and Idaho fescue are the next most common grasses. Kentucky bluegrass is invading the burned sites. Burning has apparently increased forb cover, which is 26 percent higher than in unburned grasslands. Dominant forbs are arrowleaf balsamroot, sulfur buckwheat, and yarrow. Green rabbitbrush is the only readily noticeable shrub species.

(4) Big sagebrush/Douglas-fir. This vegetation type may be an extensive ecotone between the Douglas-fir vegetation types and the big sagebrush/Idaho fescue type. As such, vegetation is similar in composition to the big sagebrush/Idaho fescue type. The major difference is the presence of invading Douglas-fir. Dominant grasses are Idaho fescue, bluebunch wheatgrass, and prairie junegrass. Forbs growing among the grasses include arrowleaf balsamroot and sticky geranium. Big sagebrush contributes most of the shrub cover.

(5) Douglas-fir/common snowberry. The overstory of this vegetation type is dominated by Douglas-fir. At higher elevations, lodgepole pine is a minor species. Below the trees, common snowberry and shiny-leaf spirea form a canopy cover of 18 percent. Vegetation of the forest floor is dominated by pinegrass. The most prevalent forbs are western meadowrue and showy aster.

(6) Douglas-fir/pinegrass. This forest type is dominated by Douglas-fir, which forms a canopy cover of 69 percent and occurs at 298 trees/acre. Shrub cover is only 2 percent. The most common shrubs are shiny-leaf spirea and snowberry. Pinegrass, followed by Idaho fescue and fowl bluegrass, are the dominant grasses. Forbs are more abundant than in the Douglas-fir/common snowberry type. Over half the forb cover is due to showy aster and weedy milkvetch.

(7) Engelmann spruce. In the study area, Engelmann spruce is restricted to stream bottoms and adjacent slopes. The Engelmann spruce type has been divided into Engelmann spruce/common horsetail, Engelmann spruce/sweetscented bedstraw, Engelmann spruce/twinflower, and Engelmann spruce/starry Solomon's seal subtypes.

Table II-11: Estimated Annual Production by Vegetation Type, Jardine Vegetation Study Area May-August, 1981 (in pounds of dry matter per acre per year)

	Vegetation Type								
Plant group	Idaho fescue/ bluebunch wheatgrass	Big sagebrush/ Idaho fescue	Burned big sagebrush	Big sagebrush/ Douglas-fir	Douglas-fir/ snowberry	Douglas-fir/ pinegrass	Engelmann[1] spruce	Subalpine fir	Quaking aspen
Perennial grasses and sedges	550	510	1,372	540	106	136	18	24	210
Forbs	353	253	665	334	212	240	153	206	514
Shrubs	61	375	0	231	66	5	186	69	197
TOTAL	964	1,138	2,037	1,105	384	381	357	299	921

Source: Westech, 1982.

[1] Production determined by averaging data from four subtypes (see text).

Table II-12: Average Tree and Shrub Density (number/acre) by Vegetation Type, Jardine Vegetation Study Area May-August, 1981

	Vegetation Types With Tree Density Measurements					
	Big sagebrush Douglas-fir	Douglas-fir/ common snowberry	Douglas-fir/ pinegrass	Engelmann spruce	Subalpine fir	Quaking aspen
Tree Species						
Douglas-fir	75	282	298	106	161	22
Lodgepole pine	0	14	0	14	128	0
Engelmann spruce	0	3	0	366	123	0
Subalpine fir	0	0	0	0	515	0
Whitebark pine	0	9	0	0	77	0
Limber pine	1	0	0	0	0	16
Quaking aspen	1	11	5	0	0	1,136
Other species	0	0	0	43	0	0

	Vegetation types with shrub density measurements		
	Idaho fescue/ Bluebunch Wheatgrass	Big Sagebrush/ Idaho Fescue	Big Sagebrush/ Douglas-fir
Shrub Species			
Big sagebrush	462	4,552	3,968
Rubber rabbitbrush	178	87	40
Green rabbitbrush	753	87	0
Prairie rose	65	0	0
Woods rose	0	0	8
Common snowberry	32	0	291
Horsebrush	146	40	0

Source: Westech, 1982.

When Engelmann spruce grows in particularly moist areas, common horsetail is the major understory species. Prickly rose, Rocky Mountain juniper, and shiny-leaf spirea grow over the horsetail.

Douglas-fir is more abundant than Engelmann spruce in the overstory of the sweetscented bedstraw subtype. Important shrubs are shiny-leaf spirea, common snowberry, and Wood's rose. Total forb coverage is high (62 percent) and includes western meadowrue and fireweed. Pinegrass grows among the forbs. Although sweetscented bedstraw identifies the subtype, it adds only 1 percent to the vegetation cover.

The twinflower subtype is characterized by an overstory of Engelmann spruce, Douglas-fir, and lodgepole pine. Blue huckleberry and thimbleberry are important shrubs. Pinegrass is the only major grass and occurs with the forbs twinflower and heartleaf arnica.

The starry Solomon's seal subtype is found on relatively dry sites. Douglas-fir and Engelmann spruce are the most abundant trees. Snowberry is a common shrub. The only significant grass is mountain brome, which is mixed with showy aster and western meadowrue.

(8) Subalpine fir. The subalpine fir type exists as two subtypes--subalpine fir/sweetscented bedstraw and subalpine fir/twinflower. The sweetscented bedstraw subtype is found along Pine Creek. Engelmann spruce and subalpine fir are common trees. The shrub layer consists mostly of thimbleberry, smooth currant, and honeysuckle. Pinegrass is the only significant grass species. Forbs include western meadowrue, twinflower, and sweetscented bedstraw.

Subalpine fir forms most of the nearly closed canopy of the twinflower subtype. Other conifers, such as whitebark pine and lodgepole pine, grow among the subalpine fir. Honeysuckle is the only common shrub while pinegrass is the only common grass. Forbs, however, are more diverse and include twinflower, heartleaf arnica, and showy aster.

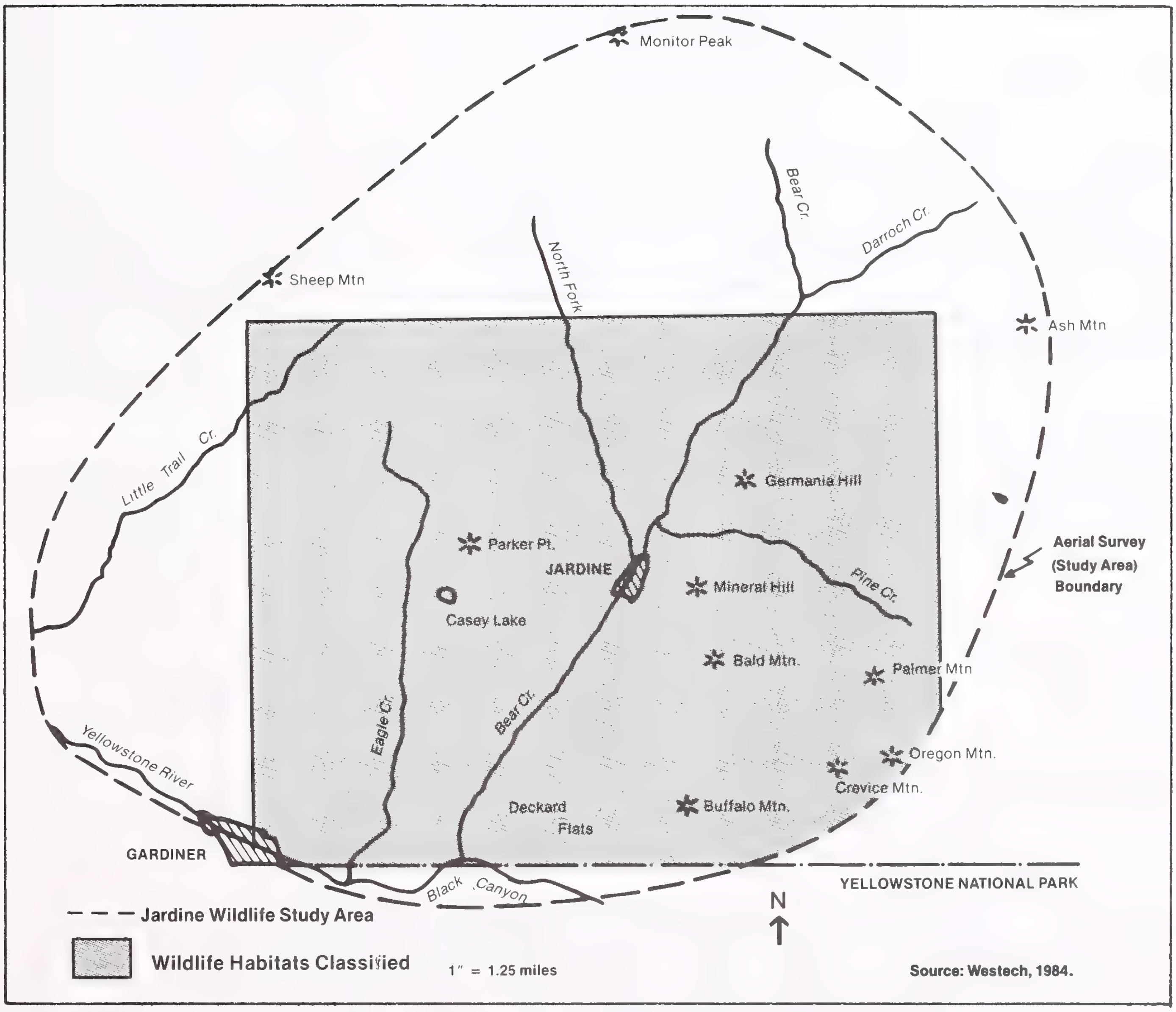
(9) Quaking aspen. Stands of aspen are found in moist sites adjacent to Douglas-fir forests. Aspen dominates the overstory with a cover of 68 percent. Douglas-fir is scattered among the aspen. The shrub cover is primarily common snowberry. Kentucky bluegrass and blue wildrye are frequently encountered grasses. The aspen type has a higher forb cover than any other type. Rocky Mountain helianthella, cow parsnip, and sticky geranium make up most of the 64 percent forb cover.

(10) Disturbance. The disturbance type includes residences in Jardine and along the county road. Also included are areas disturbed by past mining activities. An abandoned mill is located just north of Jardine and waste rock dumps are scattered throughout the study area. Most of the disturbance area, however, is comprised of two tailings pond sites. The larger site is essentially void of vegetation, while grasses and clovers grow on the smaller site.

(11) Pasture. Several horse pastures are located within the study area. The dominant plants are Kentucky bluegrass, timothy, smooth brome, and clovers.

WILDLIFE

The Jardine wildlife study area (figure II-10) adjoins Yellowstone National Park and supports abundant and diverse wildlife populations. These populations were surveyed from May 1981 through May 1982 (Westech, 1984). During baseline surveys, 28 mammal, 106 bird, 3 reptile, and 1 amphibian species were recorded (appendix 4 lists scientific names of species discussed in the text). Important elk and mule deer winter ranges, together with traditional elk migration routes, lie within the study area.



Source: Westech, 1984.

Figure II-10: The Jardine wildlife study area adjoins Yellowstone National Park and supports abundant and diverse wildlife populations.

The habitat requirements of the various animals are met by combinations of topography and vegetation types. Wildlife habitat types (table II-13) were based on existing vegetation and correspond to previously described vegetation types (see Chapter II--Vegetation). Due to mapping limitations, acreage of each type was estimated for only a portion (22,000 acres) of the entire study area (figure II-10). The lodgepole pine/subalpine fir and the big sagebrush/grassland types were the most prevalent types.

Table II-13: Wildlife Habitat Types and Corresponding Vegetation Types in the Jardine Wildlife Study Area

Wildlife habitat types	Acres	Percent of mapped study area[1]	Corresponding vegetation type
Creek bottom	290	1.3	Engelmann spruce Quaking aspen[2]
Limber pine/grass	53	0.2	--[3]
Aspen	607	2.8	Quaking aspen
Lodgepole pine/ subalpine fir	4,965	22.6	Subalpine fir
Douglas-fir/grass	2,834	12.9	Douglas-fir/pinegrass Douglas-fir/Idaho fescue
Douglas-fir/big sage	2,204	10.0	Big sagebrush/Douglas-fir
Douglas-fir/deciduous shrub	141	0.6	Douglas-fir/common snowberry
Douglas-fir/subalpine fir	3,311	15.1	Subalpine fir
Whitebark pine/ subalpine fir	620	2.8	Subalpine fir
Engelmann spruce/ subalpine fir	--[4]	--	Engelmann spruce
Big sage/grass	4,088	18.6	Big sagebrush/Idaho fescue Burned big sagebrush
Low sage/grass	--[4]	--	--[3]
Grassland	1,091	5.0	Idaho fescue/bluebunch wheatgrass
Alfalfa	90	0.4	--[3]
Disturbance	185	0.8	Disturbance
Clearcut	1,434	6.5	Subalpine fir
Scree/talus/cliff	86	0.4	--[3]
TOTALS	22,000	100	

Source: Westech, 1984.

[1] Accuracy of mapping estimated at ±15 percent; acreages and percentages by type are approximate.

[2] Also included areas dominated by cottonwood and willow that were not covered by the vegetation study.

[3] Not covered by vegetation study.

[4] Acreage not estimated.

Elk

The study area lies within the traditional winter range of the Northern Yellowstone elk herd. This herd included roughly 12,000 animals in the mid 1970s (Houston, 1982), within the 10,000 to 15,000 animal carrying capacity estimated by Houston (1982). However, by 1982 the herd had grown to about 16,000 to 17,000 individuals (Mary Meagher, National Park Service, pers. comm. in Westech, 1984), exceeding Houston's carrying capacity estimate.

The northern part of Yellowstone National Park serves as summer range for the herd. More summer range is found north of the park, primarily in the Absaroka Beartooth wilderness (figure II-11) (Jon Swenson, Montana Department of Fish, Wildlife and Parks, pers. comm., April 17, 1985). About 83 percent of the winter range is within the park. The intensity and timing of elk migration varies year to year and is primarily influenced by weather. During mild winters 90 percent of the herd remains in the park (Houston, 1982). Erickson (1981) states that significant migrations to areas outside the park occurred in about 60 percent of the winters during the 1970s. Since 1981, elk have moved out of the park in all winters (Tom Puchlerz, U.S. Forest Service, pers. comm., August 2, 1985). Migrating elk begin moving off high-elevation ranges in November. Baseline surveys indicate that large numbers of elk begin to inhabit the study area in January. Other studies (Craighead et al., 1972; Houston, 1982) indicate that significant herd use of the Jardine area begins in late December. Besides the Jardine area, the Northern Yellowstone herd uses additional winter range along the Yellowstone River (figure II-11). Many of these elk migrate through the study area as they follow traditional routes between Crevice Creek and Eagle Creek. Elk follow these routes and others back to summer ranges between early April and mid-May.

The study area is also inhabited by an estimated 350 elk of the Monitor Peak-Ash Mountain herd. These elk spend summers in the Cedar Creek-Monitor Peak-Ash Mountain area. Although seasonal movements and winter ranges are not clearly defined, some animals probably move south to share winter range with the Northern Yellowstone herd.

Between May, 1981 and May, 1982, 561 observations totalling 16,373 elk were made in the study area. Only 46 of the observations were made during summer (June 16 to September 15). Twelve of these were repeated observations from agricultural lands near Gardiner. The other sightings indicated the presence of a small resident herd west of Parker Point and represented the Monitor Peak-Ash Mountain herd. The number of observations fell to 20 in autumn (September 16 to November 30). Elk were more randomly distributed in autumn than in summer, suggesting that they move to other ranges and avoid hunters.

Observations increased sharply to 338 during winter (December 1 to March 31). Elk winter range included four concentration areas: Deckard Flats, Eagle Creek, Phelps Creek, and Little Trail Creek (figure II-12). Up to 1,500 elk were counted on Deckard Flats. Elk also used the adjacent slopes of Buffalo Mountain heavily. Late-season hunting appeared to force elk to seek security in the relatively inaccessible Little Trail Creek area. The 139 sightings made from April 1 to May 15, 1982, showed that spring range was

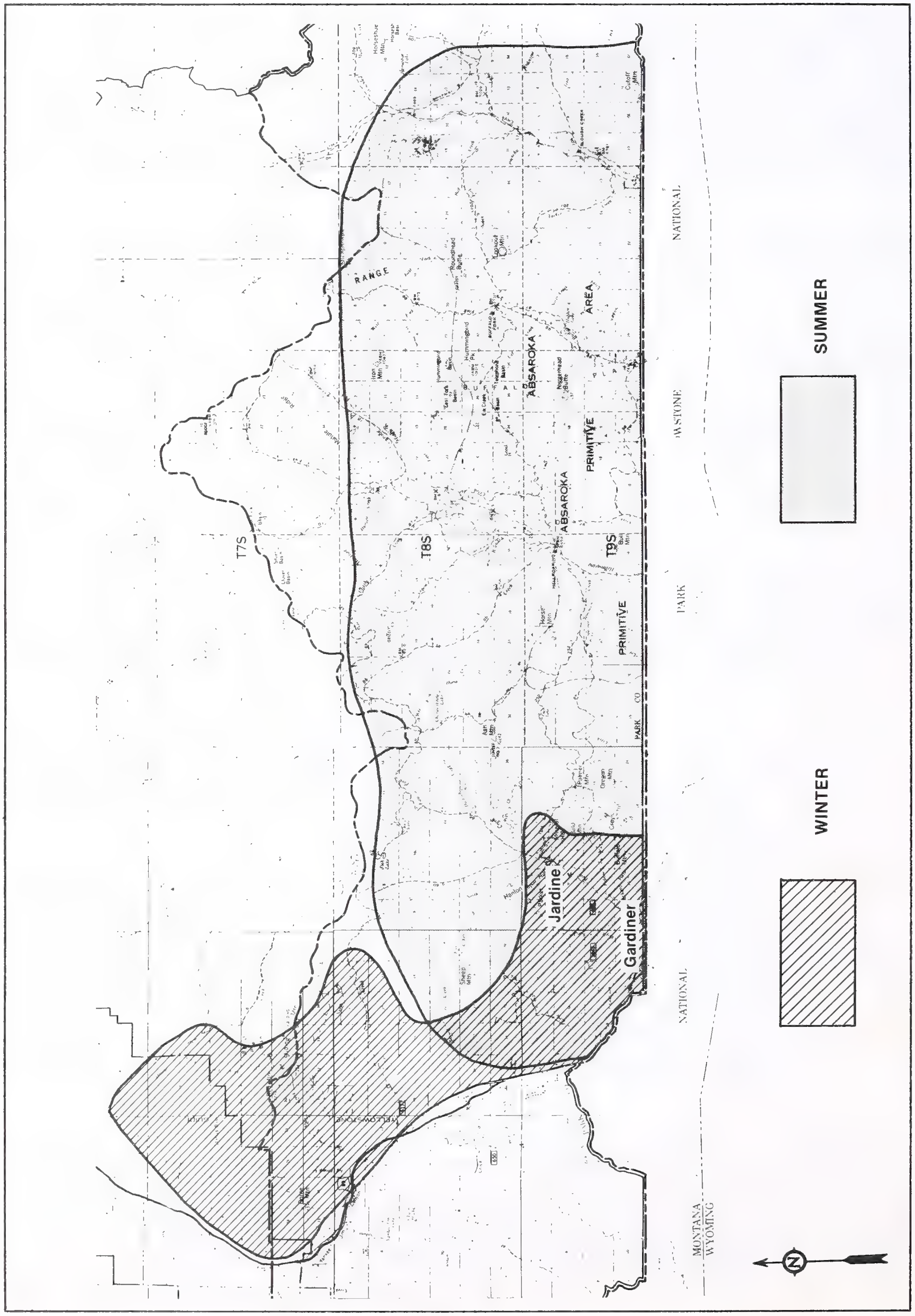


Figure II-11: Elk sighted in the Jardine study area may also use ranges in the Yellowstone River valley, Absaroka Mountains, and Yellowstone National Park. Source: Jon Swenson, Montana Department of Fish, Wildlife and Parks, pers. comm., April 17, 1985.

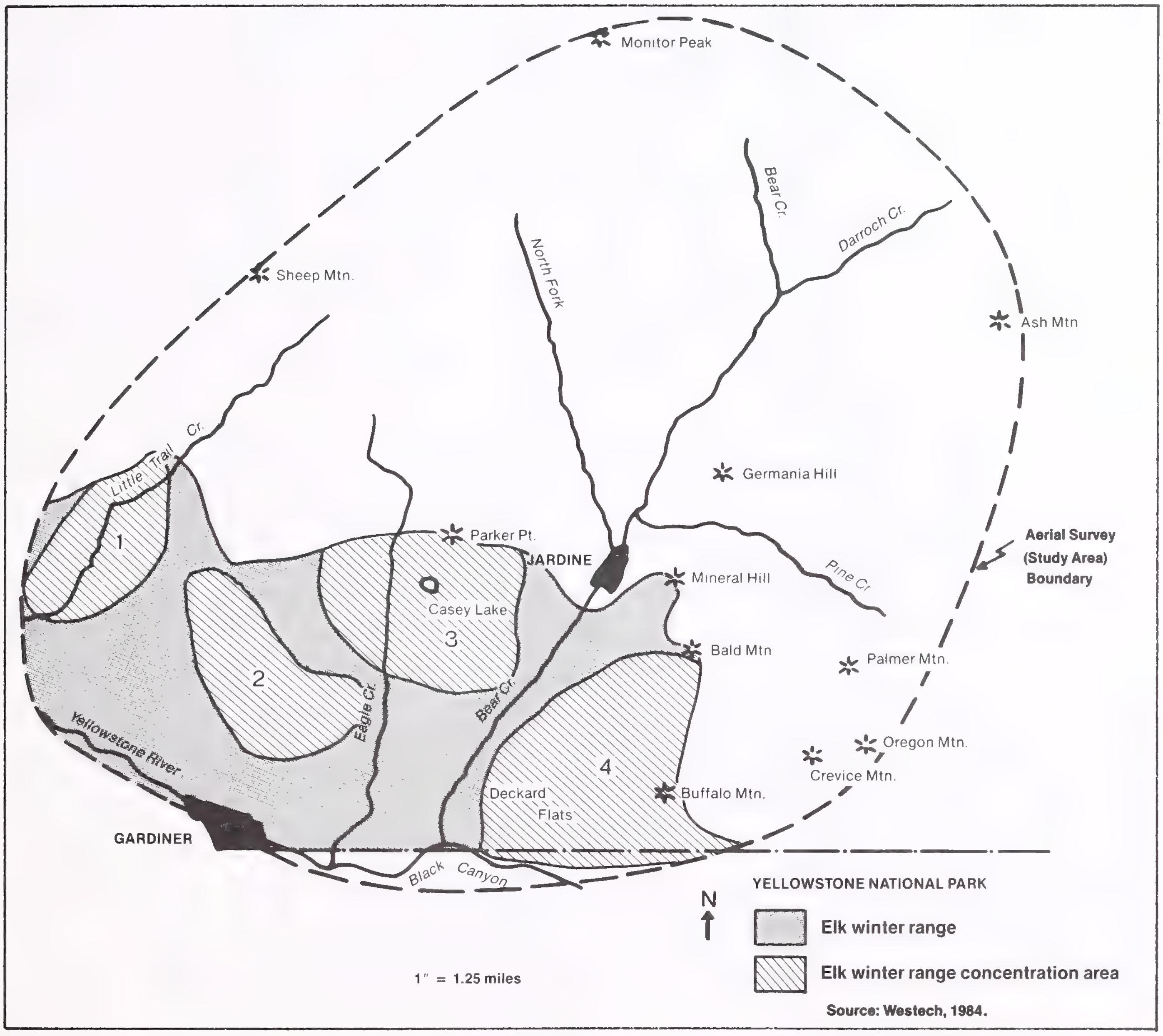


Figure II-12: Elk concentrate in certain areas in the winter. 1) Little Trail Creek; 2) Phelps Creek; 3) Eagle Creek; 4) Deckard Flats

similar to winter range. Observations of cow-calf groups north and west of Parker Point support this area's previous designation as a calving ground (Johnson, 1981). By mid-May, most migratory elk had left the study area.

While in the study area, elk used mostly the big sage/grass, Douglas-fir/big sage, Douglas-fir/grass, and grassland habitat types (table II-14). The big sage/grass type was apparently preferred and accounted for 58 percent of winter observations. This type may also provide habitat for calving during spring.

In the Jardine area, elk apparently avoided areas with more than 2 feet of snow. Their winter range is characterized by a predominance of southerly

Table II-14: Percentage of Elk Group Sightings by Habitat Type, May 1981 to May 1982, Jardine Wildlife Study Area

	Habitat Type										
Month	Creek bottom	Aspen	Lodgepole/ subalpine fir	Douglas-fir/ grass	Douglas-fir/ big sage	Douglas-fir/ deciduous shrub	Douglas-fir/ subalpine fir	Whitebark pine/ subalpine fir	Big sage/ grass	Grassland	Alfalfa
May 1981					40.0					60.0	
June				22.2					33.3	11.1	33.3
July			10.7	7.1					21.4	39.3	21.4
Aug								30.0	70.0		
Sept			10.0	20.0	40.0		10.0	20.0			
Oct				66.7		33.3					
Nov				100.0							
Dec				50.0	33.3					16.7	
Jan 1982	0.8	1.6		13.1	20.5	0.8			49.2	13.9	
Feb				9.6	17.6	0.9			66.4	5.6	
Mar		1.3		3.9	32.5				62.3		
Apr					16.1				83.9		
May		6.7			73.3				20.0		
Sample size (groups/ individuals)	1(1)	4(91)	4(6)	51(603)	115(2702)	4(15)	1(2)	5(20)	326(11833)	38(1056)	12(44)

Source: Westech, 1984.

Note: Percentages by month do not total 100 due to rounding. Blanks within the table indicate that no observations were made.

aspects and moderately steep slopes (11 to 40 percent). These features tend to shed snow and provide a warmer environment. Generally, elk used steeper slopes during winter than they did during other seasons. The percentage of winter sightings on southerly aspects (60 percent of observations) was similar to the availability of those aspects (63 percent of winter range). West and northwest aspects, often having reduced snow depths due to wind action, accounted for about 35 percent of observations.

Winter range in the study area covers about 34 square miles. During a January 1982 aerial survey, 2,041 elk were counted on the winter range. This represents a minimum density of 58 elk per square mile. Actual density is probably higher, however, because not all elk could be seen during the count. The actual density was estimated at 66 elk per square mile.

Age ratios were not determined for the study area because calves could not be distinguished during winter aerial surveys. The sex ratio was estimated at 21 males per 100 females. This ratio, however, is not entirely accurate because some antlerless males were probably classified as females. Even so, the 21:100 ratio is considerably lower than the 31:100 ratio given by Houston (1982). This lower number of males in the study area may be due to a higher proportion of males remaining inside the park during winter. Hunting and poaching may also be reducing the number of males in the study area.

Ninety-six elk carcasses were found on the study area in spring 1982. Another 135 carcasses were counted in the Northern Yellowstone herd's winter range within the park. The relatively high count in the study area was probably due to the intensive searching. Also, elk weakened by over-winter malnutrition may have died while migrating through the study area towards the park. In addition to natural winter deaths, about 780 elk were harvested from the study area during the 1981-1982 late-season hunt. Late-season hunting appears to reduce the group size of migrating elk; it also interacts with weather to affect migratory movements. Some elk are also taken during the regular season. Seven incidents of poaching were recorded. Although not measured, natural predation contributed to overall mortality. Diseases were not noted.

Mule Deer

Mule deer use the study area year-round. During summer, deer inhabit the area from Hellroaring Creek to Cinnabar Basin and Yellowstone National Park (figure II-13) (Jon Swenson, Montana Department of Fish, Wildlife and Parks, pers. comm., April 17, 1985). The winter population greatly increases as deer from Yellowstone National Park enter the area. Most of the estimated 2,000 deer in the park leave during severe winters. In contrast, mild winters encourage deer to remain. Houston (1982) reported that 65 percent of the winter range used by deer from the northern part of Yellowstone Park lies outside park boundaries along the Yellowstone River. Winter range along the Yellowstone River also receives a considerable influx of deer from summer ranges outside the park. Discernible migrations are not apparent.

On a year-round basis, mule deer were the most frequently observed species in the study area (761 observations totalling 3,866 deer); however, elk were observed in larger groups and were much more abundant during winter and early spring.

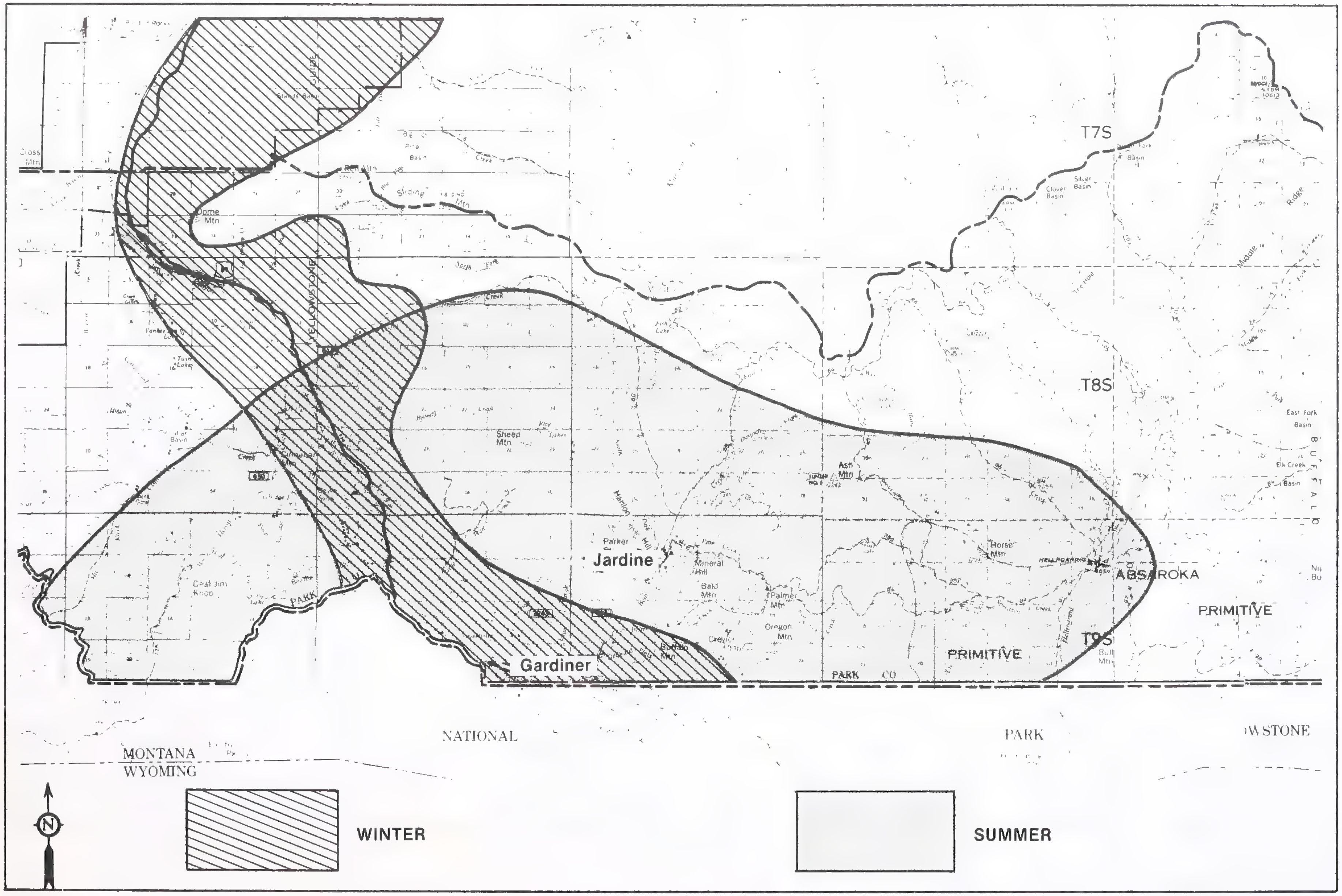
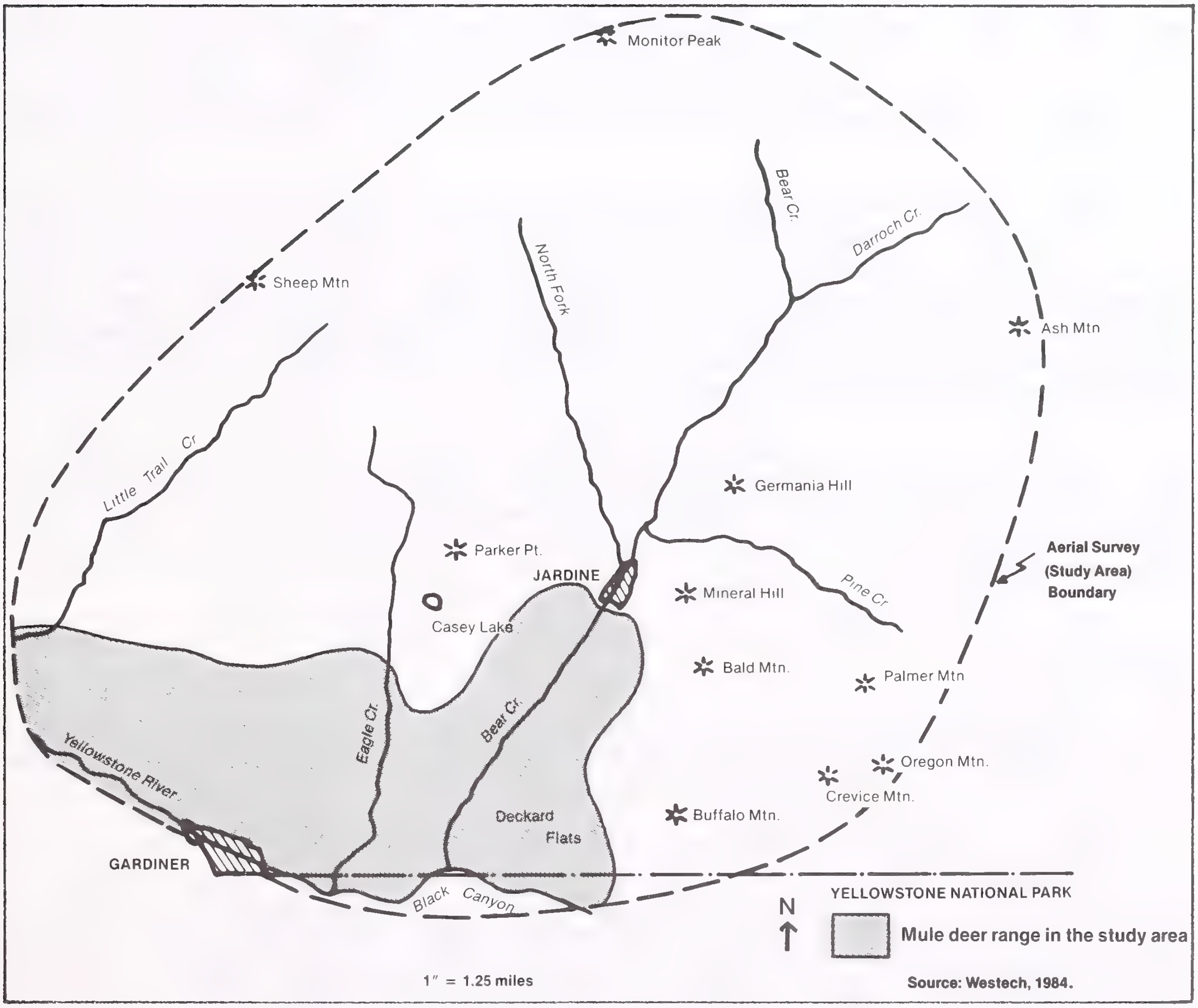


Figure II-13: Mule deer observed in the Jardine study area may also use ranges in the Yellowstone River valley, Absaroka and Gallatin Mountains, and Yellowstone National Park. Source: Jon Swenson, Montana Department of Fish, Wildlife and Parks, pers. comm., April 17, 1985, and Jerry T. Light, U.S. Forest Service, pers. comm., April 12, 1985.

With the exception of low-elevation, open habitats, summer observations of mule deer were scattered throughout the study area (figure II-14). Autumn distribution was similar to summer distribution although deer had started using lower elevations. With the onset of winter many more deer entered the study area. Mule deer inhabited most of the elk winter range but were more restricted to lower elevations by snow. The few deer seen at higher altitudes were using paths or feeding sites previously made by elk. Early spring range (before May 15) was similar to winter range while by late spring the number of observations fell sharply to resemble the pattern of the previous summer.



Source: Westech, 1984.

Figure II-14: During winter, mule deer use the area indicated by shading within the study area.

On a year-round basis, deer depended primarily on the big sage/grass, Douglas-fir/big sage, and creek bottom habitat types (table II-15). The big sage/grass type was heavily used in the winter and may have been a preferred type. Big sage/grass lands also accounted for most spring observations. During summer and autumn, the deer remaining on the study area shifted to high-elevation forests; however, deer were more visible in open habitats and the big sage/grass type continued to contribute observations. Sixteen does with fawns were sighted in spring 1981. Although fawning occurred in the study area, specific sites were not identified.

Most winter observations of mule deer came from slopes of 11 to 30 percent. Unlike elk, deer did not show an increased use of steeper slopes during winter. The proportion of deer using southerly aspects (78 percent) was greater than the availability of those aspects (63 percent).

Although mule deer and elk used similar winter ranges, competition between the two species was not evident. The low levels of competition were probably due to the difference in habitat use. Compared to elk, mule deer used lower elevations, gentler slopes, and more southerly aspects. Deer did not depend on the windswept ridges and grasslands that were important to elk. Different foraging habitats further served to reduce competition (Houston, 1982).

Winter range in the study area covers about 20 square miles. In April 1982, 180 deer (9 deer per square mile) were counted in this winter range; however, after adjustments were made to compensate for animals unobservable from the air, estimates of 29 to 30 deer per square mile were obtained. These figures are close to the density of 34.5 deer per square mile estimated by Houston (1982). Deer within the study area occur in ratios of 41 males to 100 females and 56 fawns to 100 females.

Mule deer mortality was attributed to winter malnutrition, predation, hunting, and poaching. The major predators were coyotes and mountain lions. The study area is within Montana Department of Fish, Wildlife and Parks' Hunting District 313. The 1981 regular season harvest from this district was 380 mule deer.

Bighorn Sheep

Houston (1982) described a bighorn sheep range that generally followed a wide corridor along the Yellowstone River between Dome Mountain and the Lamar River. The study area included a very small portion of this range.

Bighorn lived year-round in rugged habitats along the Black Canyon of the Yellowstone (10 observations). They were also observed on Deckard Flats (3 observations), Buffalo Mountain (1 observation), Crevice Mountain (1 observation), and just north of Gardiner (1 observation). Bands observed on Deckard Flats ranged from 9 to 22 individuals. The minimum winter population in the study area was 21 sheep. Bighorn used mostly big sage/grassland and cliff habitat types. Although lambing grounds were not located, lambs were observed in the study area. Mortality of bighorn was due to hunting, predation, and disease.

Moose

Moose were sighted on 20 occasions in the study area (26 individuals). They inhabited major drainages and forested areas. There were no apparent

Table II-15: Percentage of Mule Deer Group Sighting by Habitat Type May 1981 through May 1982, Jardine Wildlife Study Area

	Habitat Type										
Month	Clearcut	Creek bottom	Limber pine/ Idaho fescue	Aspen	Lodgepole pine/ subalpine fir	Douglas-fir/ grass	Douglas-fir/ big sage	Douglas-fir/ deciduous shrub	Douglas-fir/ subalpine fir	Big sage/ grass	Grassland	Alfalfa
May 1981		5.1		6.8	3.4	1.7	28.8		1.7	49.1	3.4	
June	11.1	5.6		5.6	22.2	22.2	22.2			11.1		
July	7.7				11.5	19.2	15.4			26.9	19.2	
Aug	11.8	5.9			17.6	11.8	11.8		23.5	17.6		
Sept	21.7	8.7		17.4		21.7		17.4	8.7	4.3		
Oct	8.1	2.7		2.7	18.9	18.9	16.2	10.8	13.5	8.1		
Nov				12.5	12.5	25.0				50.0		
Dec		2.4					21.4	4.8		64.3	4.8	2.4
Jan 1982		8.2	3.6	2.7		4.5	20.0			60.0	0.9	
Feb		7.5	0.9				13.1			78.5		
Mar		1.3	0.6	0.6		0.6	6.3			90.6		
Apr		1.3					9.2			86.8		2.6
May		1.3					3.8			78.5		16.5
Sample size (groups/ individuals)	14(26)	30(104)	6(14)	11(44)	24(43)	27(56)	103(382)	6(14)	14(35)	499(2870)	11(33)	16(240)

Source: Westech, 1984

Note: Percentages by month do not total 100 due to rounding. Blanks within the table indicate that no observations were made.

seasonal changes in moose density nor were any distinct elevational movements indicated. Six cows with calves were sighted. These calves were probably born somewhere in the study area. Moose can be legally hunted in the study area; some poaching may also occur.

Bison

Deckard Flats and areas along the Yellowstone are considered historic bison winter range (Mary Meagher, National Park Service, in Westech, pers. comm., 1984). Current bison use of the study area, although increasing, is sporadic. During baseline studies, only four bison were seen. Twelve to fifteen bison inhabited the Eagle Creek area during spring, 1984 (Ken Czarnowski, Resource Management Specialist, National Park Service, pers. comm., July 25, 1985).

Black Bear

A total of 13 black bears were observed on 7 occasions. Their tracks or hair were found at 7 locations. Black bears apparently den along lower Bear Creek and upper Pine Creek. Their life requirements are satisfied by a variety of habitat types. The presence of females with cubs indicates that birth occurs in the study area. In 1981, hunters killed one bear along upper Bear Creek and another along upper Eagle Creek. (Grizzly bears are discussed in Chapter II--Threatened and Endangered Species.)

Mountain Lion

No mountain lions were seen in the study area. Tracks, however, were noted in the Black Canyon of the Yellowstone, along lower Bear Creek, and on Deckard Flats. An area resident reported an incident of lion predation on a bighorn.

Small- and Medium-sized Mammals

Nine species of small mammals were trapped: deer mouse, common shrew, red-backed vole, meadow vole, western jumping mouse, yellow pine chipmunk, red squirrel, Columbian ground squirrel, and northern flying squirrel. Deer mice were the most frequently trapped species and occurred in all habitat types. Their maximum home range was 1.1 acre. Shrews inhabited the clear-cut and creek bottom types while red-backed voles lived in forested areas. As expected, the meadow vole was captured only in moist habitats. The other five species were captured infrequently.

Mountain cottontails, yellow-bellied marmots, and porcupines were commonly observed herbivores. White-tailed jackrabbits and snowshoe hares were less common. Weasels, martens, and coyotes were frequently observed predators. Coyote density on the study area fell during winter. This decline was caused by trapping or emigration. Coyote dens exist on Mineral Hill and on lower Eagle Creek. Other predators inhabiting the study area were red foxes and bobcats.

Raptors (Birds of Prey)

Sixteen raptorial species were observed in addition to the bald eagle and peregrine falcon (see Chapter II--Threatened and Endangered Species). American kestrels were the most common nesting raptors. Three red-tailed hawk nesting territories were identified, and a suspected nest was located along Bear Creek. Two nesting territories of great horned owls were discovered. Other species possibly nesting in the study area were: goshawk, Cooper's hawk, sharp-shinned hawk, prairie falcon, merlin, and long-eared owl. Golden eagles hunted over open habitats along Eagle Creek and the Yellowstone River. Swainson's hawks, ferruginous hawks, rough-legged hawks, northern harriers, ospreys, and short-eared owls were all occasionally observed in the study area.

Songbirds

Forty-three songbird species were seen from May to July along survey transects (appendix 3). The mountain chickadee, the dark-eyed junco, the chipping sparrow, and the robin were among the most common species.

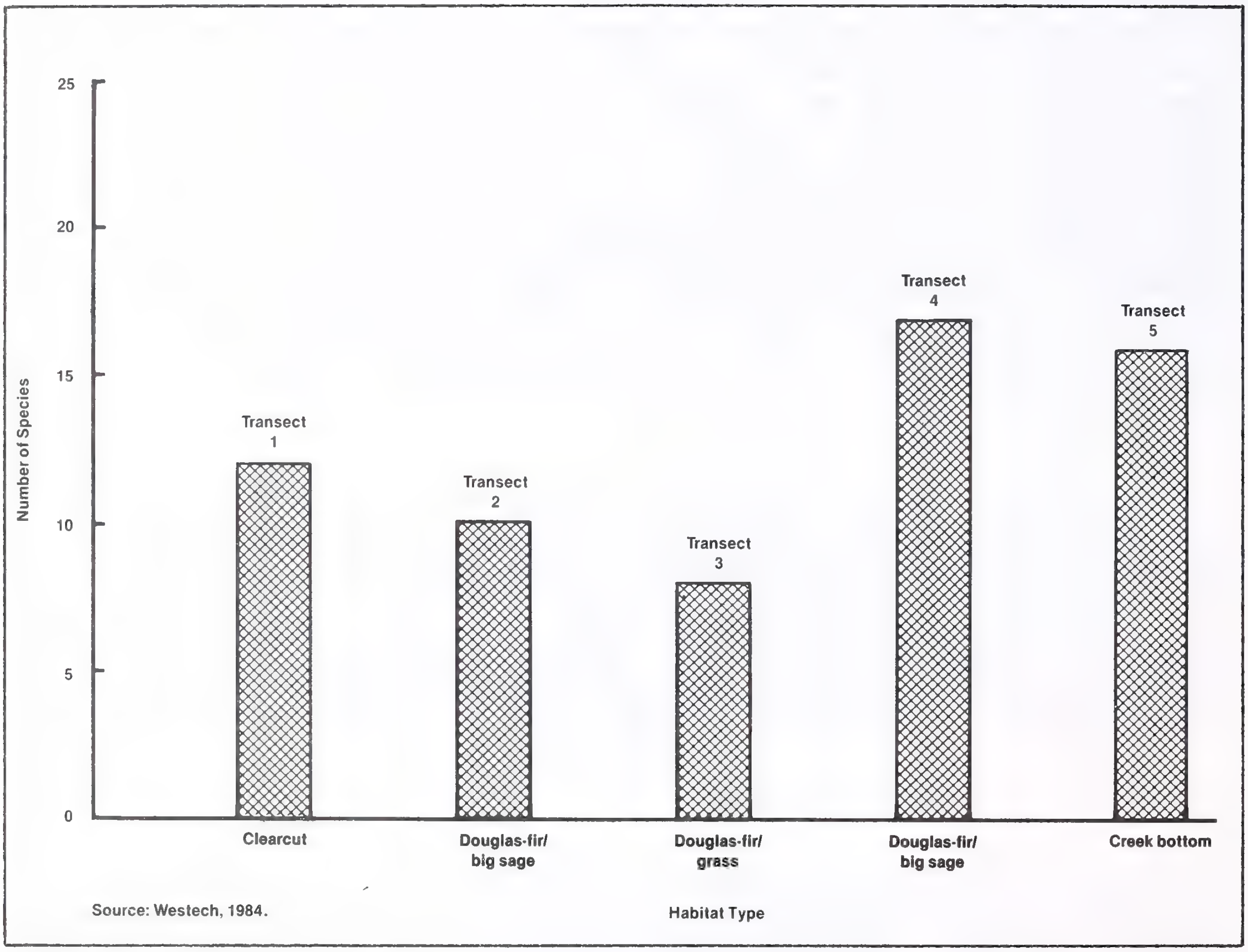
Creek bottom and Douglas-fir/big sage habitat types supported the highest number of species (figure II-15). The greatest number of species inhabited the study area in June, while the least number was present in December. Several species were year-round residents.

Gamebirds and Waterfowl

Ruffed grouse used creek bottom habitat types along lower Eagle Creek and lower Bear Creek. Blue grouse were observed at higher elevations in a variety of habitat types. They were present in all seasons. Waterfowl recorded during baseline surveys were mallards, gadwalls, pintails, green-winged teal, blue-winged teal, and common mergansers. Waterfowl are commonly observed along the Yellowstone River and Bear Creek (T. Puchlerz, USFS, pers. comm., February 3, 1986). Mallard observations are concentrated at Casey Lake and Penstock and Blanding ponds. Common mergansers, Barrow's goldeneyes, and mallards nest in the study area.

Reptiles and Amphibians

All three reptile species seen in the study area lived below an elevation of 7,200 feet. Racers and prairie rattlesnakes inhabited grassland and big sage/grass habitats. Garter snakes were associated with riparian habitats. The lone amphibian species, the spotted frog, was common near water at upper elevations.



Source: Westech, 1984.

Figure II-15: Creek bottom and Douglas-fir/big sage habitat types support the highest number of species of songbirds.

THREATENED AND ENDANGERED SPECIES

The assessment area for threatened and endangered species makes up the southwestern portion of the Hellroaring/Bear (Creek) Bear Management Unit (see figure II-16).

At the request of the U.S. Forest Service, the U.S. Fish and Wildlife Service provided a list of threatened and endangered species that could occur in the assessment area (U.S. Fish and Wildlife Service, pers. comm., October 19, 1984). The list was comprised of one threatened and three endangered animal species (table II-16). There are no federally listed threatened and endangered plants (U.S. Fish and Wildlife Service, 1984) within the assessment area. Pursuant to Section 7 of the Endangered Species Act, the U.S. Forest Service prepared a biological assessment for the listed species (Light, 1986).

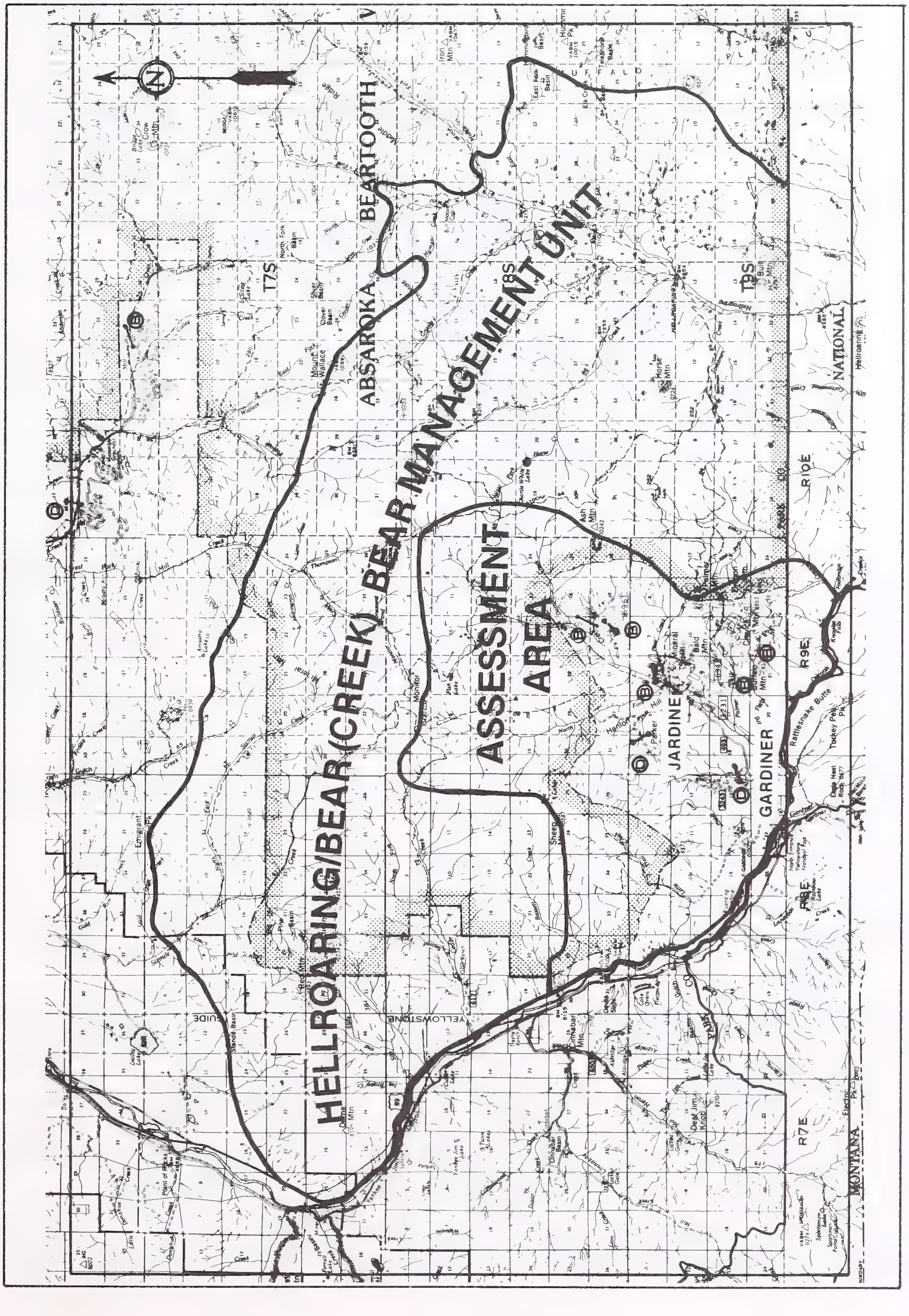


Figure II-16: The proposed project would take place within the "threatened and endangered species" assessment area shown here. This assessment area is part of the Hellroaring/Bear (Creek) Bear Management Unit. Source: U.S.D.A. Forest Service, 1985a.

Table II-16. Threatened and Endangered Species That Could Occur in the Assessment Area

Species[1]	Federal classification	Status in assessment area
Grizzly bear	Threatened	Year-long resident
Bald eagle	Endangered	Winter and spring resident
Peregrine falcon	Endangered	Spring and fall migrant
Gray wolf	Endangered	Unknown

[1] See appendix 4 for scientific names.

The description of existing environment and impact analysis presented in this EIS are consistent with the biological assessment.

Grizzly Bear

Radio telemetry and direct observations are used to determine grizzly bear distribution, population changes, and habitat use. Knight and Eberhardt (1985) included the Jardine area in a high-density grizzly bear zone of the Yellowstone ecosystem (figure II-17). The large home ranges of grizzlies suggest that the proposed permit area may sometimes be used by grizzlies from distant areas. The U.S. Fish and Wildlife Service (1982) lists average home ranges for females at 105 square miles and states that some individuals roam over 1,000 square miles.

Before their relocation in the early 1980s, three radio-collared females inhabited the assessment area. Grizzlies or grizzly sign were observed 13 times near Jardine in 1981 and 1982 (Westech, 1984). From 1983 to 1984, 24 grizzly bear observations were made in the area east of Gardiner (National Park Service, 1985). During the late summer and fall of 1984, three grizzlies were observed in the assessment area, according to the Interagency Grizzly Bear Study Team (IGBST, 1984). Figure II-18 shows observations made from 1975-1984.

From 1981 to 1984, a total of 121 bear management actions were taken by government agencies (National Park Service, 1985). These actions, some occurring in the assessment area, included the destruction of some bears and the relocation of others from the Yellowstone area (table II-17). Grizzlies are also killed by poachers and die from natural causes. Females apparently have particularly high mortality rates (IGBST, 1979-1982). In light of such mortality, the IGBST (1982) has expressed concern about the grizzly population's continued existence in the Yellowstone area. Knight and Eberhardt (1985) present evidence indicating that the population may be declining.

Craighead and Craighead (1977) reported six grizzly mortalities in the assessment area from 1959 through 1974. Between 1975 and 1980, one grizzly was killed in the assessment area (Knight et al., 1975-1982). Because the

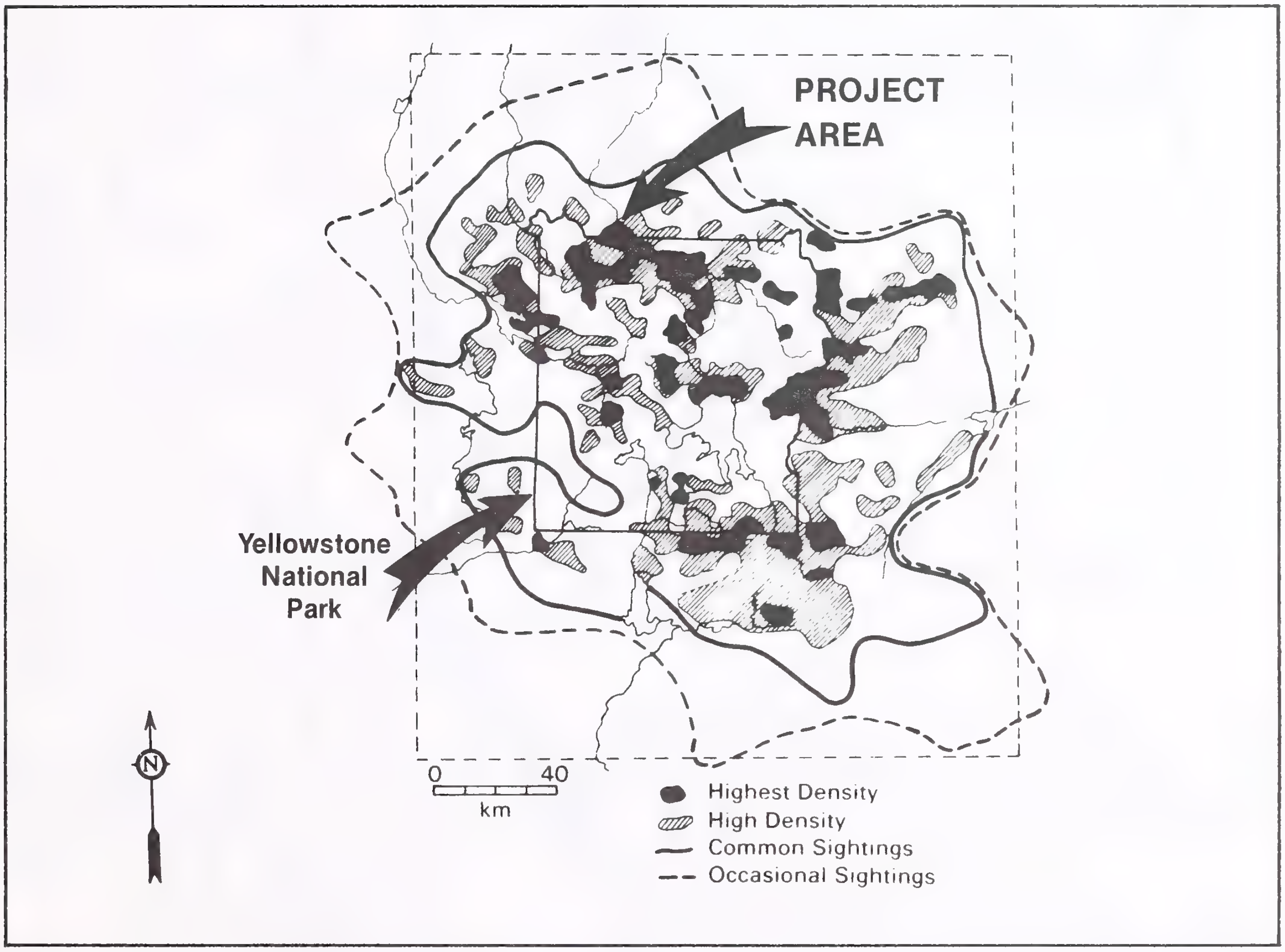


Figure II-17: Knight and Eberhardt (1985) included the Jardine area in a high-density grizzly bear zone of the Yellowstone ecosystem.

assessment area constitutes less than 1 percent of occupied grizzly bear habitat, these incidents represent a relatively high number of mortalities.

Bear management actions are taken when conflicts occur between grizzlies and humans. Conflicts can arise when grizzlies become accustomed to using foods brought in by people. In 1983, conflicts in the assessment area were resolved by trapping and relocating three female grizzlies. Conflicts and subsequent management actions are not unique to the assessment area; actions have also been taken near the towns of West Yellowstone and Cooke City and in some developed areas in Yellowstone National Park.

Climate influences the number of conflicts between grizzlies and humans. Certain climatic conditions, such as mild winters, summer frosts, and little summer precipitation, reduce the availability of natural grizzly foods. The bears expand their foraging range, sometimes including residential and recreational areas.

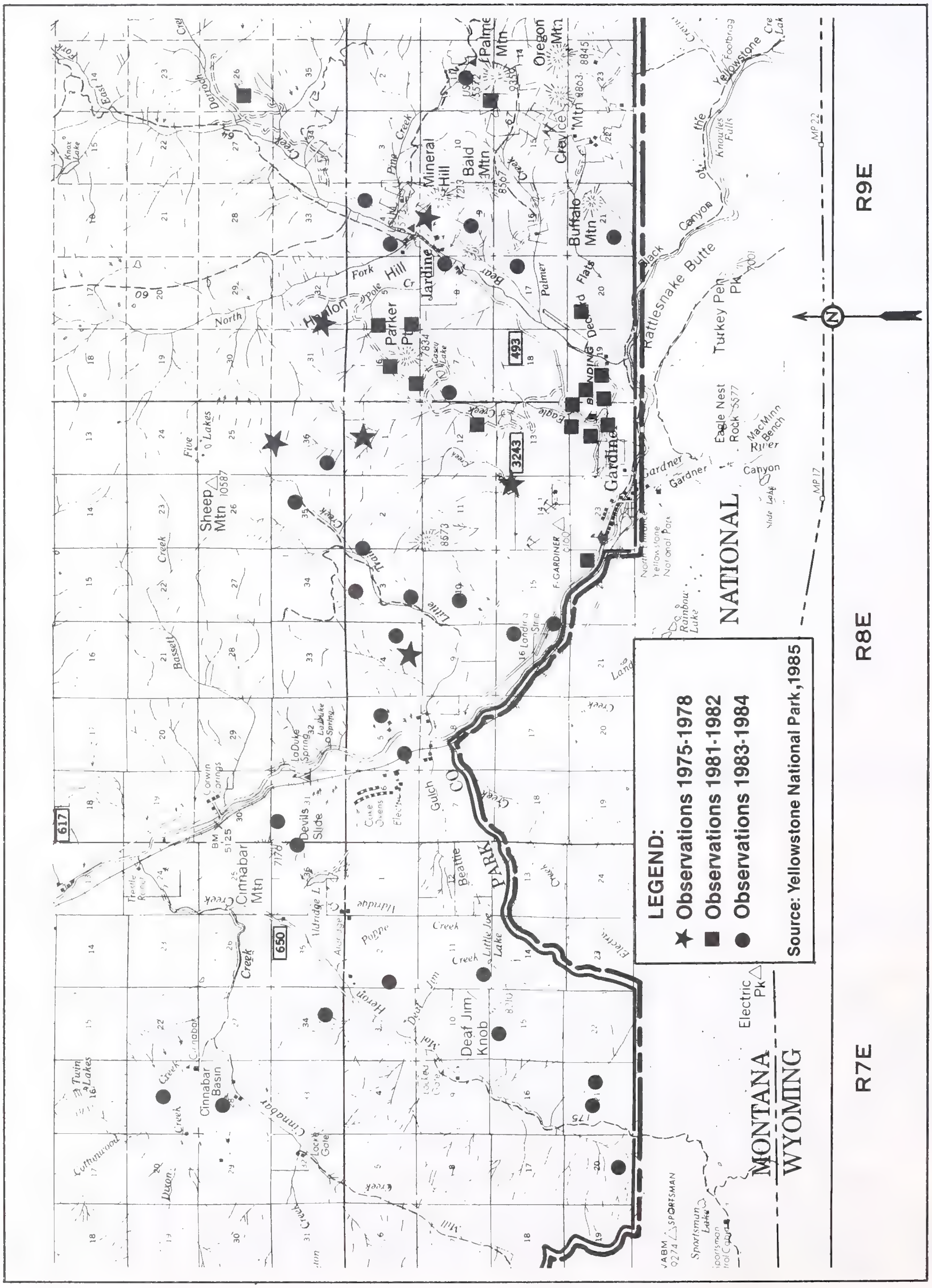


Figure II-18: Observations in the assessment area detail the use of the habitat by grizzly bears.

Table II-17. Bear Management Actions in the Yellowstone Area, 1981-1984

Year	Total actions in Yellowstone area[1]	Removal from Yellowstone area: Mortality	Removal from Yellowstone area: Relocation	Removal from assessment area: Mortality	Removal from assessment area: Relocation
1981	49	17	1	3	2
1982	25	3	3	0	2
1983	19	4	3	2	3
1984	28	7	2	0	1
Totals	121	31	10	5	8

Source: U.S. Department of the Interior, National Park Service, 1985.

[1] Some actions involved relocating a bear to another part of the Yellowstone area.

Grizzly bears use a variety of habitat types to satisfy their life requirements (table II-18). Interagency Grizzly Bear Study Team methodology has been used to classify most habitats in the Yellowstone area. The assessment area encompasses suitable year-round habitats (figure II-19). Five seasonal habitats are described below:

Spring (April 1-June 15). Elk carrion and succulent plants are the primary grizzly foods during the post-denning period. After emerging from their dens, grizzlies search for these foods in Douglas-fir forests and big sage/grasslands. Carrion and plant foods are most abundant in low-elevation areas with southerly aspects.

Summer (June 16-August 15). Grizzlies often forage in mountain grasslands. These high-elevation grasslands occur in the assessment area and contain preferred plant foods (table II-18). Summer frosts or low precipitation, however, can severely reduce the quantity and quality of these plants.

Early Fall (August 16-September 30). Whitebark pine nuts in the subalpine fir/whitebark pine/grouse whortleberry and the whitebark pine/grouse whortleberry habitat types attract grizzlies. Grizzlies also seek succulent plants in meadows and drainages.

Late Fall (October 1-November 30). Before entering their dens, grizzlies obtain whitebark pine nuts by raiding squirrel caches. Rut-weakened elk and moose, inhabiting forested areas, provide higher-quality food.

Winter (December 1-April 30). Grizzlies spend most of the winter in dens. The best denning habitat in the Yellowstone area is usually above 8,100 feet, on steep slopes (30°-60°) and in the subalpine fir/grouse whortleberry, subalpine fir/whitebark pine/grouse whortleberry, and whitebark pine/grouse whortleberry habitat types (U.S. Forest Service, 1985).

Table II-18: Grizzly Bear Habitat in the Assessment Area

Season	Habitat Factor	Climax Habitat Type[1]
Spring	Cover	Douglas-fir types Engelmann spruce types
	Forage	Big sagebrush/Idaho fescue Big sagebrush/bluebunch wheatgrass Idaho fescue/bluebunch wheatgrass Bluebunch wheatgrass/Idaho fescue Douglas-fir types
Summer	Cover	Engelmann spruce types Subalpine fir types
	Forage	Subalpine fir/huckleberry Subalpine fir/twinflower/grouse whortleberry Idaho fescue/tufted hairgrass Tufted hairgrass/sedge Idaho fescue/threadleaf sedge
Early Fall	Cover	Engelmann spruce types Subalpine fir types
	Forage	Subalpine fir/whitebark pine/grouse whortleberry Whitebark pine/grouse whortleberry Idaho fescue/tufted hairgrass Tufted hairgrass/sedge Idaho fescue/threadleaf sedge
Late Fall	Cover	Subalpine fir types
	Forage	Subalpine fir/whitebark pine/grouse whortleberry Subalpine fir types
Winter	Cover	Subalpine fir/grouse whortleberry Subalpine fir/whitebark pine/grouse whortleberry Whitebark pine/grouse whortleberry

Source: Jerry T. Light, USDA Forest Service, Gallatin National Forest, pers. comm., June, 1985.

[1] See appendix 12 for scientific names. Grassland and shrub/grassland types follow Mueggler and Stewart (1980) while forest types follow Pfister et al. (1977).

Bald Eagle

From November through March, bald eagles are often sighted along the Yellowstone River. Their primary foods are fish and elk carrion. Westech (1984) reported 28 observations (49 individuals) of bald eagles in the study

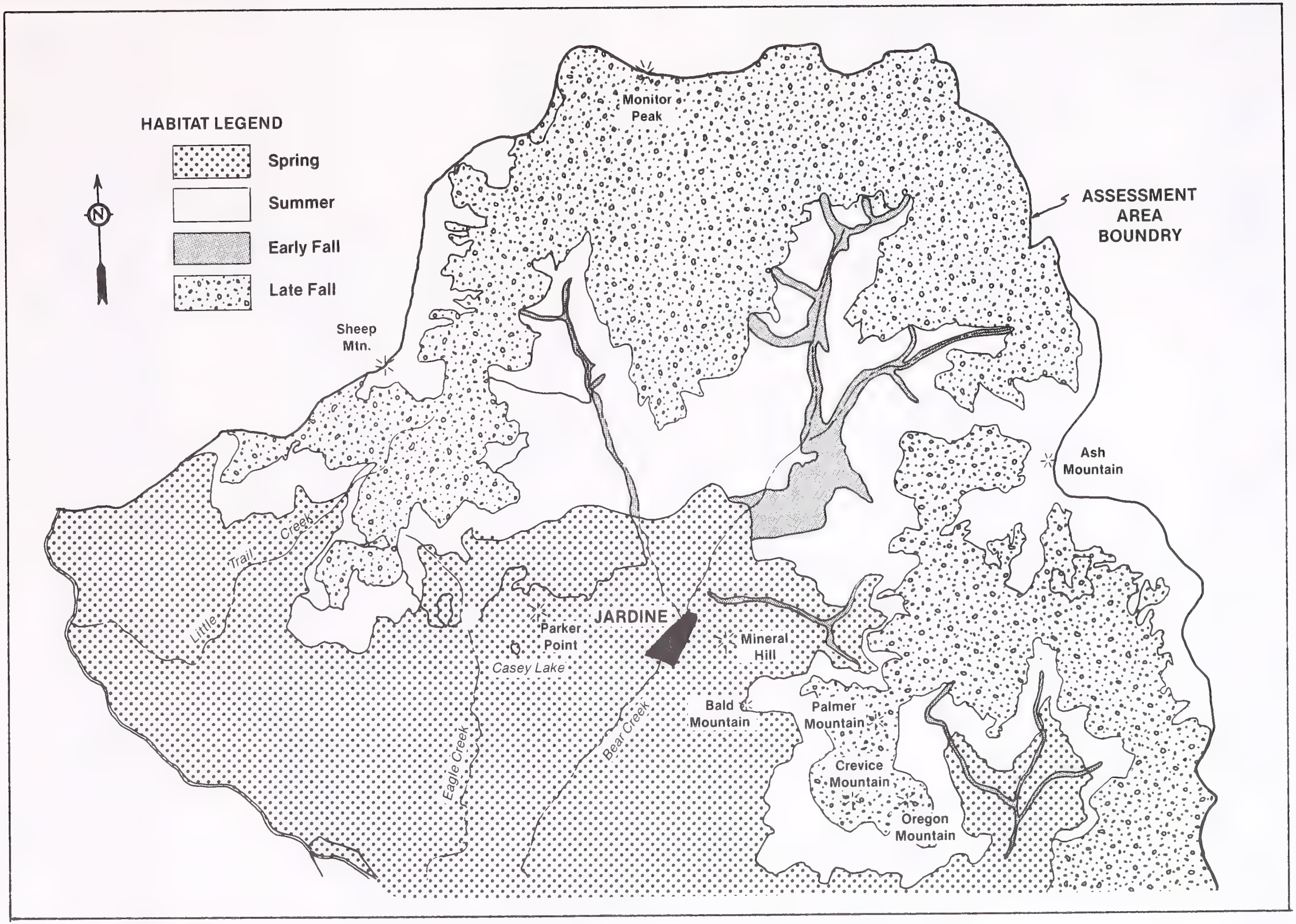
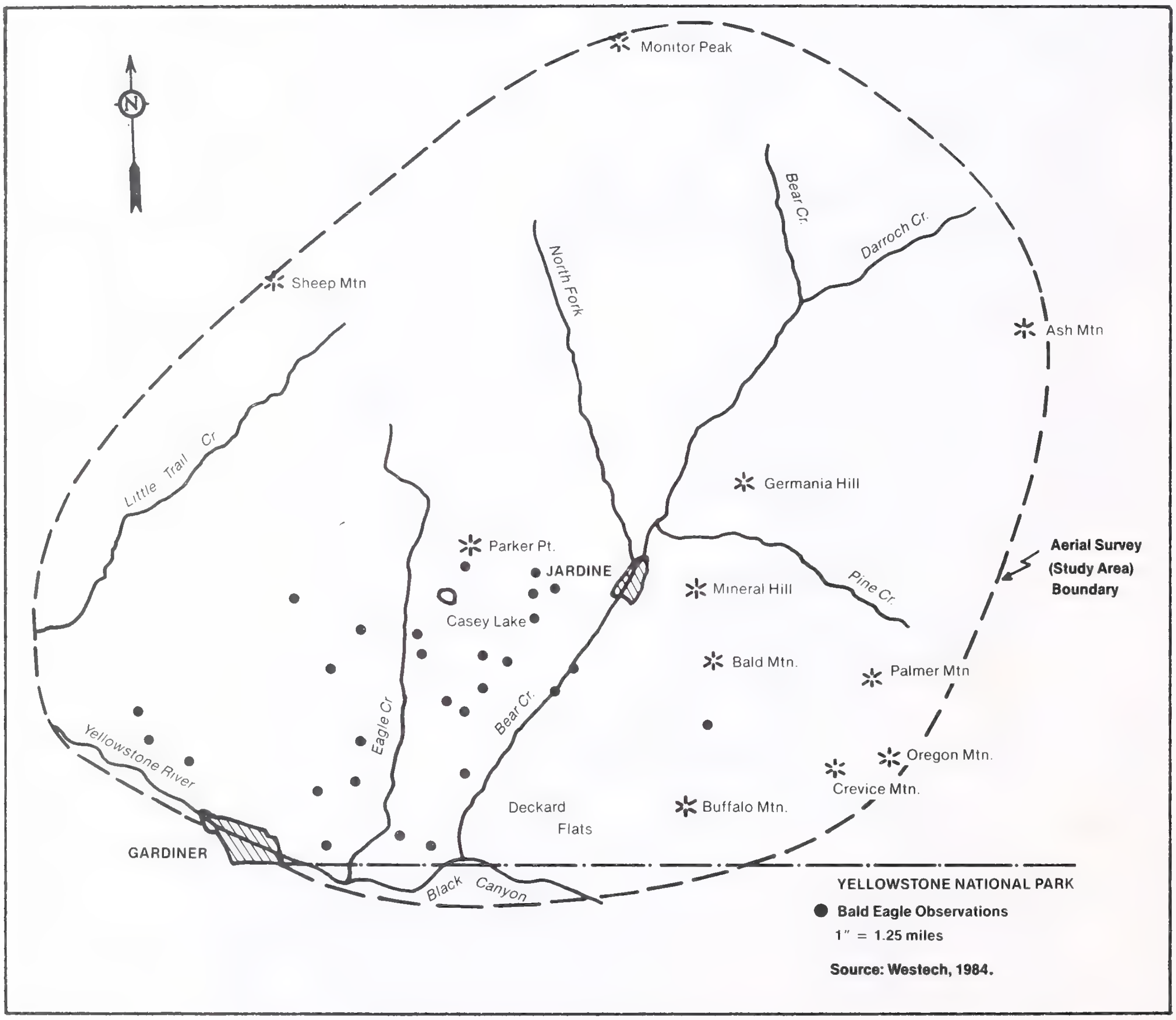


Figure II-19: Grizzly bear habitat use changes with the season. The assessment area includes suitable year-round habitats, detailed here by season.

area during the winter of 1981-82 (figure II-20). Eagles tend to roost in groups; 11 roosting birds were sighted in a tree along lower Bear Creek. J.T. Light (U.S. Forest Service, pers. comm., July 8, 1985) also reported eagles roosting on a ridge north of Phelps Creek.



Source: Westech, 1984.

Figure II-20: Westech (1984) reported 28 observations of 49 bald eagles in the assessment area during the winter of 1981-82.

Two nests along Bear Creek, about one mile below Jardine, resemble bald eagle nests; however, eagle use of these nests after 1979 is not documented. One nest is deteriorating and the other has been used by red-tailed hawks. Swenson (1975) reported no bald eagle nesting territories in the assessment area.

Peregrine Falcon

Only one peregrine falcon has been recorded in the assessment area. Westech (1984) reported a peregrine flying over a big sagebrush/grassland on March 19, 1982. No nests have been found; however, there are some suitable habitat and nest sites in the assessment area. Wetlands, important hunting habitat to these birds, are found along the Yellowstone River and south of Blanding Guard Station. Cliffs provide suitable nest sites along the Yellowstone River and at the mouth of Bear Creek (Tom Puchlerz, U.S. Forest Service, pers. comm., July 10, 1985). Other suitable nest sites are 3 to 7 miles outside the assessment area.

Government agencies are currently introducing peregrine falcons in the Yellowstone area. More successful reintroductions could increase the importance of habitats in the assessment area.

Gray Wolf

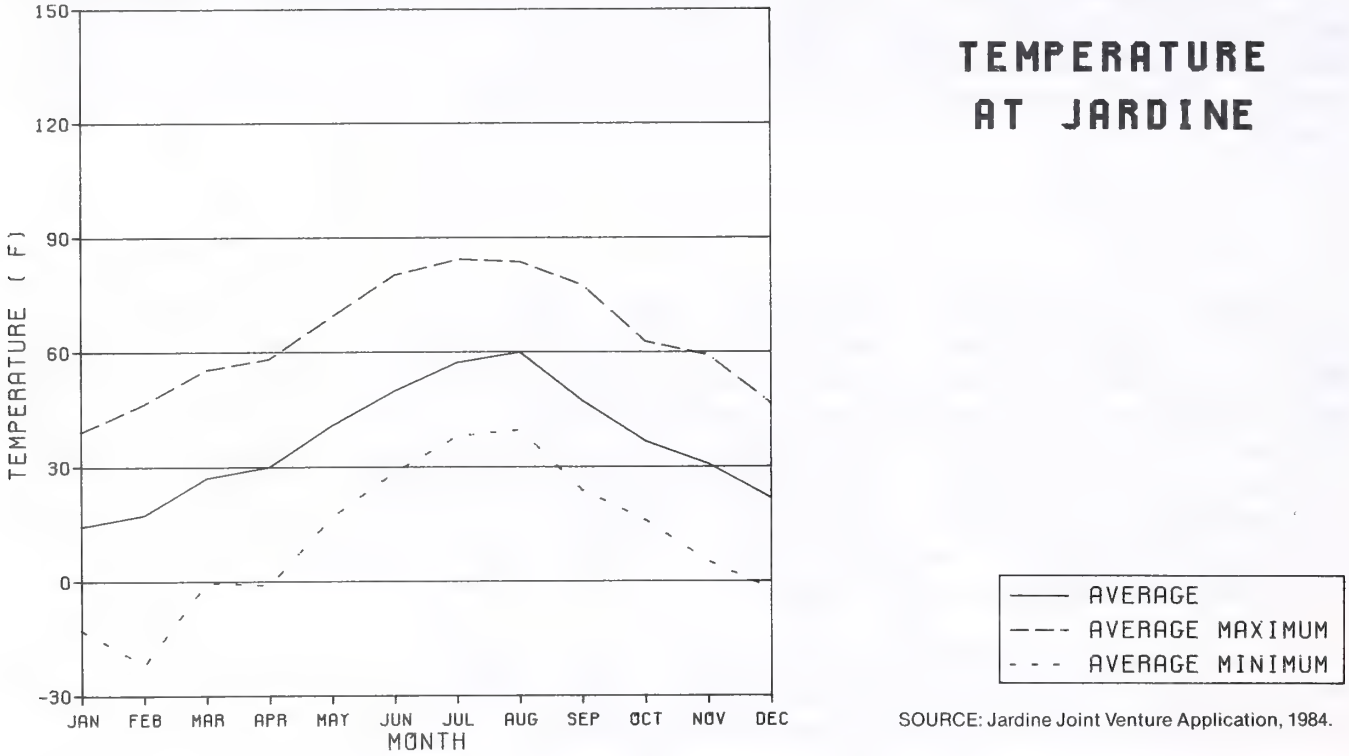
Although the existence of gray wolves in the assessment area has yet to be disproven, it is unlikely that they are residents. Wolf packs were probably eliminated from Yellowstone National Park in the 1920s (Weaver, 1978). Scattered individuals may roam the park today, but their presence is not well documented. If wolf populations recover, elk would supply an ample prey base.

CLIMATE

Climate in the Jardine project area is characterized by long, cold winters and short, cool summers. Wind speeds are usually less than seven miles per hour; wind direction follows the orientation of the valley generally from the northeast or southwest.

Temperature

During the period August 6, 1981 through September 30, 1982, the highest temperature recorded at Jardine was 85°F in July and August; the coldest was -22°F in February. Monthly averages ranged from a high of 57°F in August to a low of 14°F in January. Figure II-21 presents monthly average maximum, average minimum, and average temperatures for the Jardine area during the study period.



SOURCE: Jardine Joint Venture Application, 1984.

Figure II-21: The average temperature at Jardine was about 36°F during the period October 1, 1981 through September 30, 1982. August was the warmest month and January the coldest.

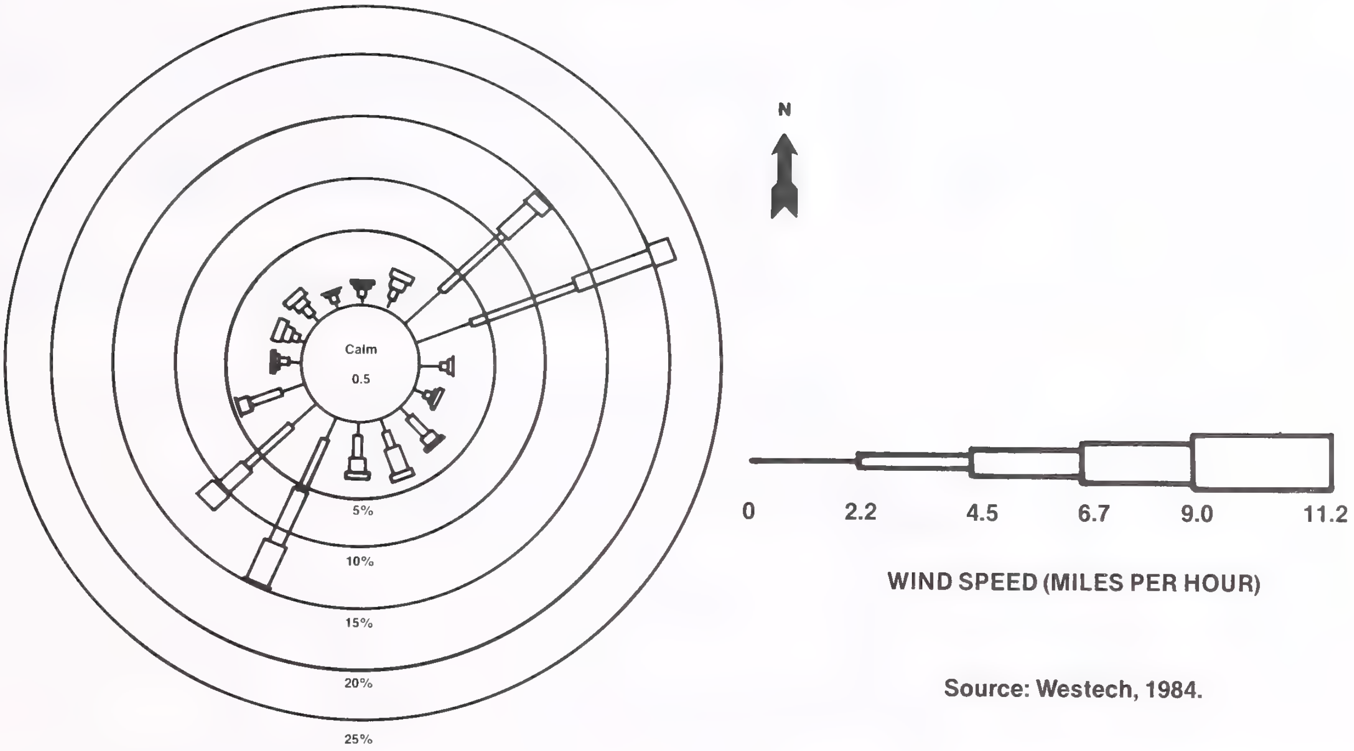
Winds

For the year of baseline study, 37 percent of the winds were down-valley (from the northeast and east-northeast) while 27 percent of the winds were up-valley (from the southwest and south-southwest). Only during the July-September quarter did this pattern change. The predominant flows were from the southeast, south-southeast, or northwest and north-northwest (figure II-22).

Wind speeds were low. No average hourly wind speed greater than 13.5 miles per hour (mph) was recorded. However, calm periods were essentially nonexistent. About 62 percent of the hourly average wind speeds were less than 4.5 mph, 88 percent were less than 6.7 mph. However, local residents say high winds occur frequently.

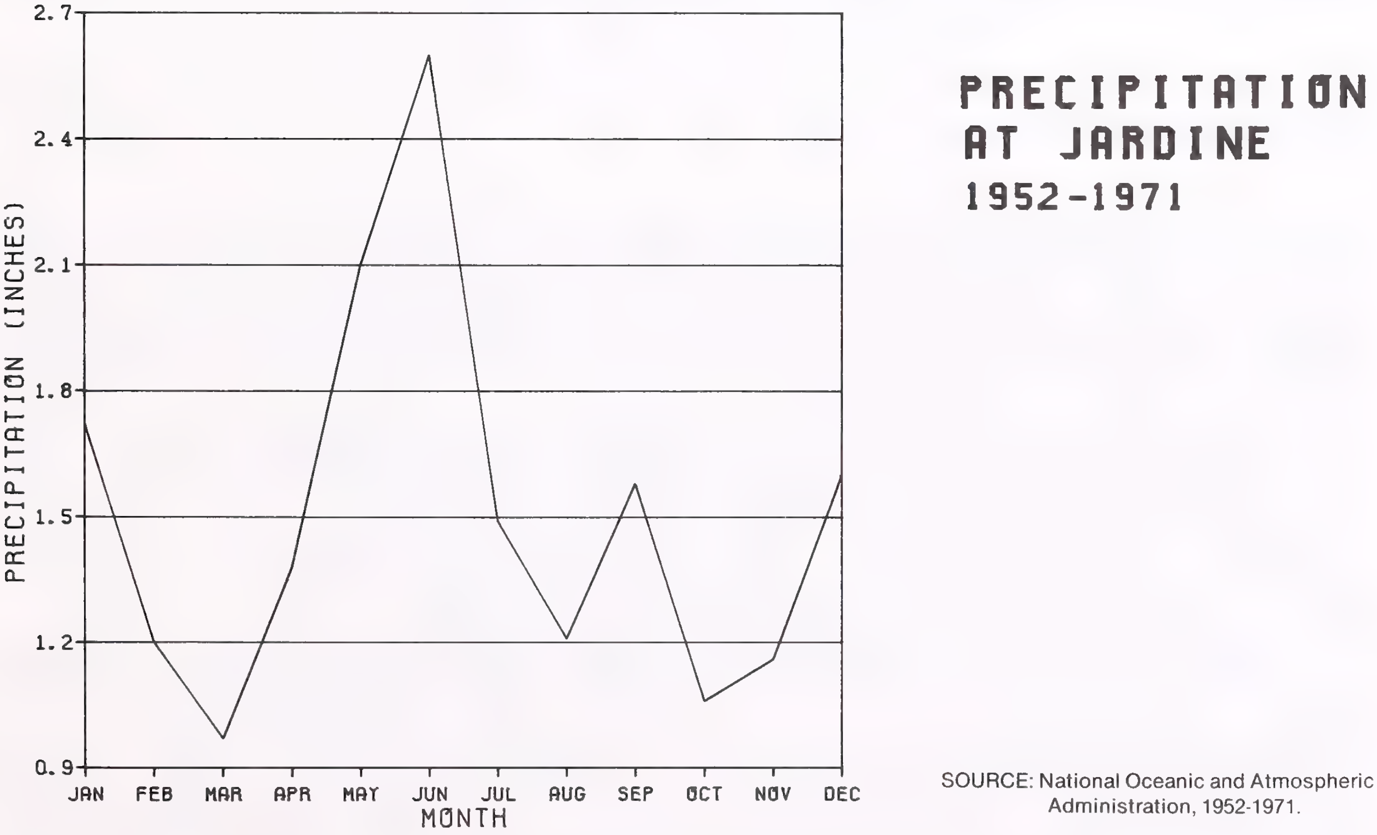
Precipitation and Evaporation

Precipitation was also measured during the study period August 1981 through September 1982 (project application, 1984). However, the information presented here is based on 20 years of data collection by the National Weather Service (NOAA, 1952-1971). Annual average precipitation is about 18 inches, ranging from 12.0 inches to 35.4 inches. June is the wettest month with 2.6 inches of precipitation, and March the driest with 1.0 inches (figure II-23). The frequency of precipitation events and probable maximum precipitation are shown in table II-19.



Source: Westech, 1984.

Figure II-22: Wind speeds measured at the mine site were generally below seven miles per hour. Winds blew from the northeast and southwest most of the time, following the Bear Creek drainage.



SOURCE: National Oceanic and Atmospheric Administration, 1952-1971.

Figure II-23: Average annual precipitation at Jardine is less than 18 inches. Seasonally, most of the precipitation occurs as rain during the spring. June is the wettest month, and March the driest.

Table II-19: Frequency and Probable Maximum of Precipitation

	Recurrence Intervals (Years)					
	2	5	10	25	50	100
6-Hour Event	0.7	1.0	1.2	1.2	1.6	1.8
24-Hour Event	1.0	1.4	1.8	2.2	2.6	2.8

Probable Maximum Precipitation (inches)

Frequency	Maximum Precipitation
1 Hour	5
6 Hours	9
24 Hours	19
72 Hours	26

Source: Miller et al., 1984.

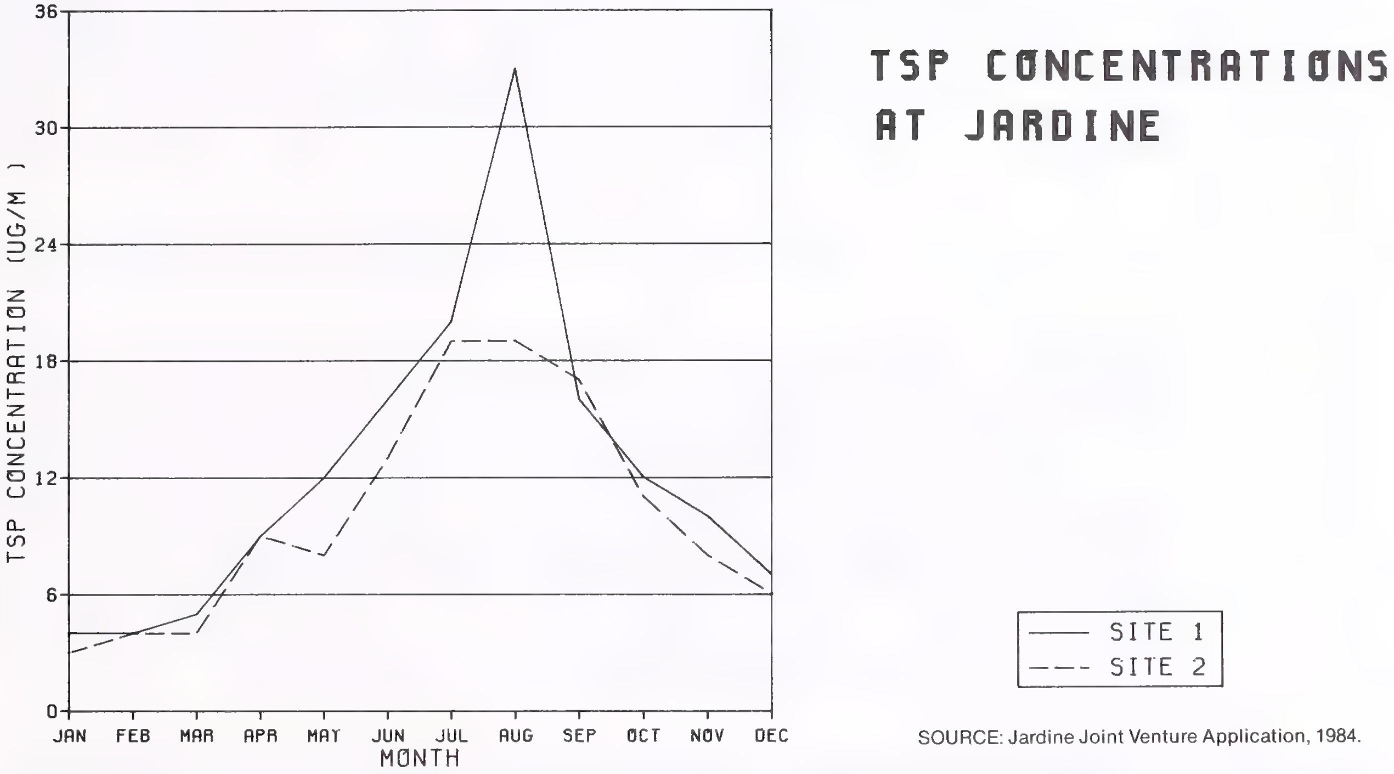
Average annual evaporation (open water) is about 27 inches. Virtually all evaporation occurs from April through October, ranging from 2 inches in October to 5.8 inches in July.

AIR QUALITY

The air quality measured at two monitoring stations near Jardine is good; however, during windy periods, dust plumes eminate from the existing tailings area. For the monitoring period of September 1981 through August 1982 the annual average total suspended particulate (TSP) concentration was about 20 micrograms per cubic meter (μg/m³), well below the Montana Ambient Air Quality Standard (MAAQS) of 75 μg/m³.

TSP concentrations were greatest during the warmer months (figure II-24), probably due to windblown dust from exposed areas--the existing tailings pond in particular--and roads. During the winter, these areas are frozen or snow covered. The highest 24-hour TSP concentration, 52 μg/m³, was recorded in June. This level is well below the MAAQS of 200 μg/m³.

Trace element analysis was performed on the filters from the baseline monitoring program. The analysis included arsenic, cadmium, chromium, and lead. This analysis revealed high arsenic values at the site northeast of the project area. There is no ambient air quality standard for arsenic. Because of this, the Air Quality Bureau uses a set of guidelines developed from occupational health threshold limit values to evaluate potential problems.



SOURCE: Jardine Joint Venture Application, 1984.

Figure II-24: Average total suspended particulate (TSP) concentrations were highest during the summer months, but well below all applicable standards throughout the year.

The annual average for this site was 0.101 μg/m³ compared to the guideline value of 0.07 μg/m³ for arsenic.

The data was reported in monthly averages with significantly higher averages in September and November 1981 and August 1982. Due to the wide variation in the data, it is assumed the primary source was blowing tailings from the existing tailings area. This would correspond to the variability in blowing tailings episodes. During the summer of 1985, the applicant applied chemical stabilization to the surface of the existing tailings area which should lower the arsenic levels. Due to historic mining in the area and the high arsenic content of the ore, arsenic levels will probably remain somewhat higher than in other areas.

Vehicle traffic, residential space heating, and mine exploration are the only potential gaseous pollutant sources in Jardine. Therefore, gaseous air pollutants, such as sulfur dioxide, ozone, nitrogen oxides, are present in only very low concentrations.

Visibility

A visibility study of the Jardine area was conducted at Mammoth, Wyoming (within Yellowstone Park) during 1981-82 (Tree and Hunt, 1982). Using a telephotometer and camera to measure visibility, the study concluded that visibility within the Jardine Basin is no different than visibility in the overall study region. The existing tailings pond is visible from the upper terraces at Mammoth.

INCOME

Total Park County personal income (not adjusted for inflation) grew from $50,519,000 in 1973 to $120,682,000 in 1983--almost 140 percent. However, inflation averaged 7.14 percent per year over that time period (Survey of Current Business, July 1975 and July 1984, implicit price deflator for personal consumption expenditures) (see figure II-25). Adjusting personal income figures for inflation shows that total Park County personal income increased 18 percent from 1973 to 1983, or 1.4 percent per year (see figure II-26). Per capita income, in constant dollars, barely kept pace with inflation, increasing from $4,104 in 1973 to $4,216 in 1983, for an average annual increase of 0.24 percent above inflation (see appendix 7).

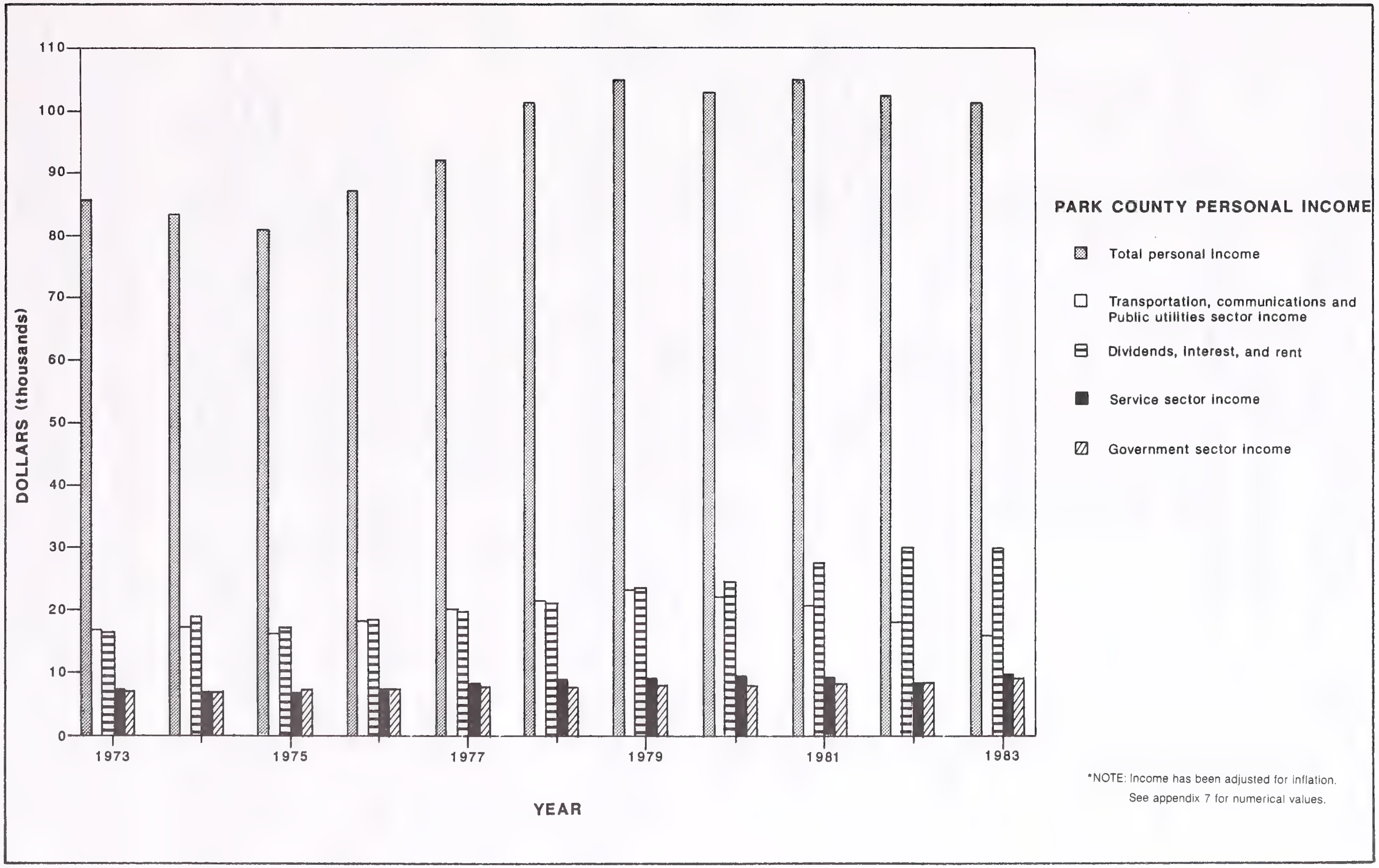
Labor income, including wages and salaries, contributed the largest percentage to total county personal income (50.9 percent) in 1983. Dividends, rent, and interest--the second largest component--accounted for almost one-third of total personal income (see figure II-25).

Transfer payments (social security, unemployment compensation, and social welfare payments) comprised about 18.0 percent of 1983 Park County personal income. Such payments have become a larger percentage of county personal income over the last five years. In 1979, transfer payments equaled 13.5 percent of total Park County personal income.

The transportation, communication, and public utilities sector accounted for 15.7 percent of total Park County income in 1983. This sector has been the largest employment- and income-producing sector in Park County, producing above 30 percent of total income between 1978 and 1982. However, due to the reduction in force by Burlington Northern Railroad, its total contribution to Park County income and employment has declined. Closure of the BN repair shop in Livingston will cause a $10 million decline in personal income--almost 8 percent of the total personal income in Park County in 1983.

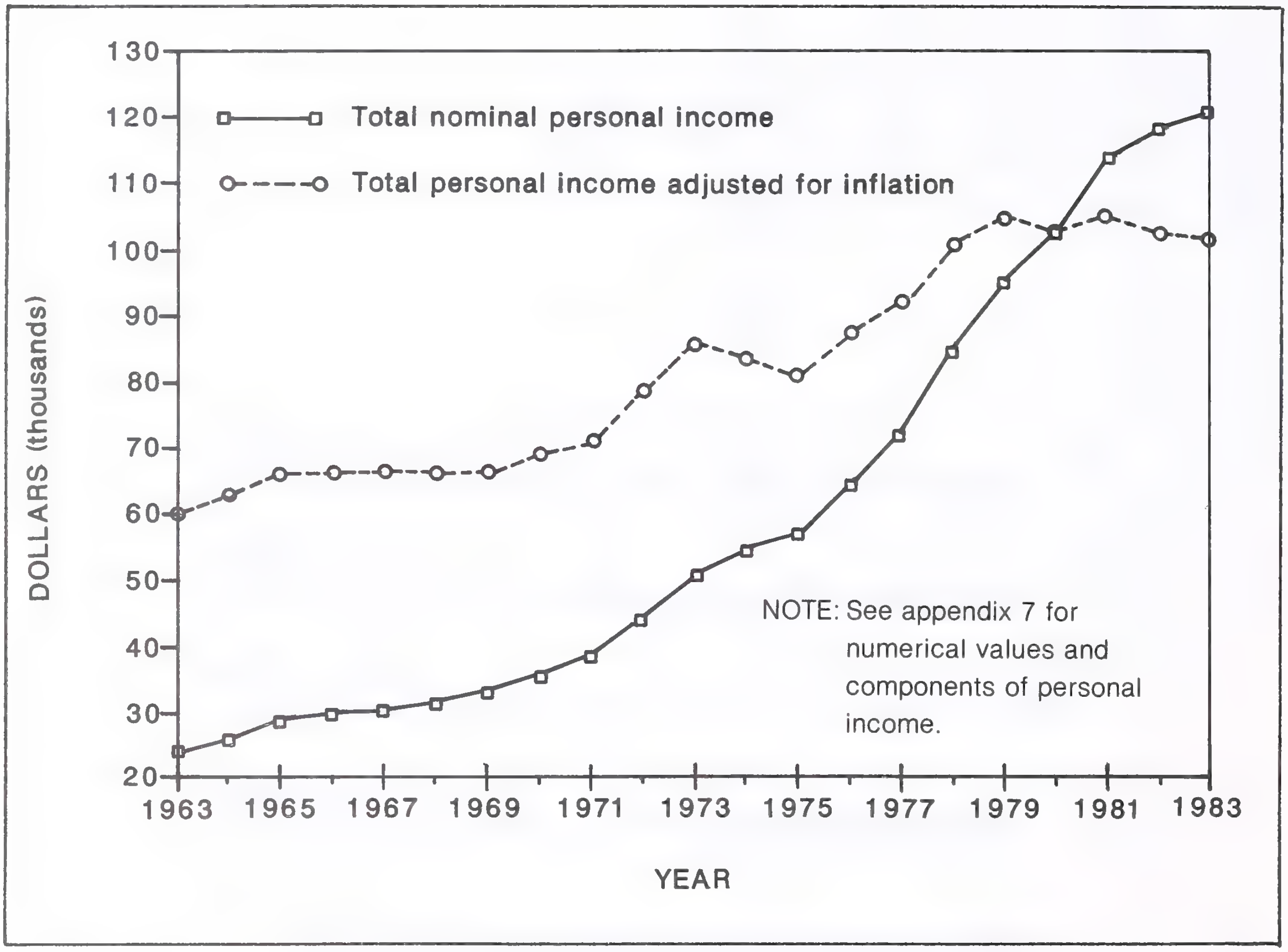
The service and government sectors are the next largest income producers in Park County, providing 9.6 and 8.8 percent, of total income. Retail trade employment, accounting for 8.0 percent, is the only other sector contributing above 8 percent to total income in Park County.

Park County farm income was affected by the recession more than other sectors. Farm income (in constant 1980 dollars) peaked in 1973 at $10.0 million and dropped 77.2 percent to less than $1.0 million in 1983 (see appendix 8). The agricultural sector declined statewide, although not as much as in Park County. Between 1981 and 1983, statewide agricultural income declined 33.6 percent to $214.2 million in 1983.



*NOTE: Income has been adjusted for inflation.
See appendix 7 for numerical values.

Figure II-25: Park County personal income grew almost 140 percent from 1973 to 1983.



NOTE: See appendix 7 for numerical values and components of personal income.

Figure II-26: Per capita incóme barely kept pace with inflation from 1973 to 1983.

Personal Income

Personal income is projected to increase about 67 percent from 1980 to 2010 (see table II-20). Such income forecasts are consistent with historic rates of change over the last 24 years.

Per capita (per person) income shows a 44 percent increase from 1980 to 2010, rising from $7,871 to $11,300. Such an increase represents an annual average increase of about 1.2 percent. The forecast is in constant 1980 dollars and does not include inflation.

EMPLOYMENT

The effects of the 1980-1982 recession are still present in Park County. The total number of jobs is still below the pre-recession peak employment in 1979. Closure of the Burlington Northern railroad (BN) shop and declines in

Table II-20: Projections of Baseline Personal Income, Park County[1]
1980 to 2010 (in thousands of 1980 dollars)

Year	Total personal income	Population	Per capita income
1980	$101,297	$12,869	$ 7,871
1985	104,535	13,200	7,919
1990	107,255	13,150	8,156
1995	119,549	13,500	8,855
2000	133,251	13,900	9,586
2005	148,524	14,250	10,423
2010	165,548	14,650	11,300

Source: Economic Consultants Northwest, sociology section, 1984, population forecasts. DSL working papers, February 1986, are the sources for income forecasts.

[1] Yellowstone National Park is included.

[2] Population and income forecasts reflect closure of the BN shop in Livingston.

the agriculture in Park County employment contributed to the recent decrease in Park County employment. Total employment in Park County increased from 1970 to 1982 (see figure II-27). However, employment peaked in 1979 at 5,827 jobs and declined almost 5 percent between 1979 and 1982. Total employment in Montana followed a similar course--increasing from 1970 to 1983, with a peak of 373,238 jobs in 1979 (see appendix 9).

Employment declines in Park County and Montana were caused by the 1980-1982 recession and the loss of high-paying jobs in basic industries. Basic industries are those that sell products and materials to businesses or people from outside the state (in the case of Montana) and outside the county (in the case of Park County). Montana lost over 7,000 basic industry jobs, in part due to the shutdown of the Milwaukee Railroad and the closure of all Anaconda Company mining and smelting operations (*Economics Montana*, March 1985, p. 1). Park County basic industry employment declined due to layoffs by BN and transfer of Mountain Bell employees to Billings. BN employment was about 1,100 at one point during 1979, but declined to about 450 employees in 1983 (Mountain International, 1984a, p. 270). In February 1986 the BN repair shop was closed permanently. About 187 employees accepted transfers to other BN jobs outside Park County (Marvin Varnes, Shop Superintendent, BN, pers. comm., February 12, 1986).

Park County manufacturing employment declined from its highest level of 483 jobs in 1976 to 293 in 1982. Closure of Birkeland Studs, Inc., a wood products manufacturer, contributed a loss of 150 to 200 basic industry jobs in the manufacturing sector (Mountain International, 1984a, p. 271).

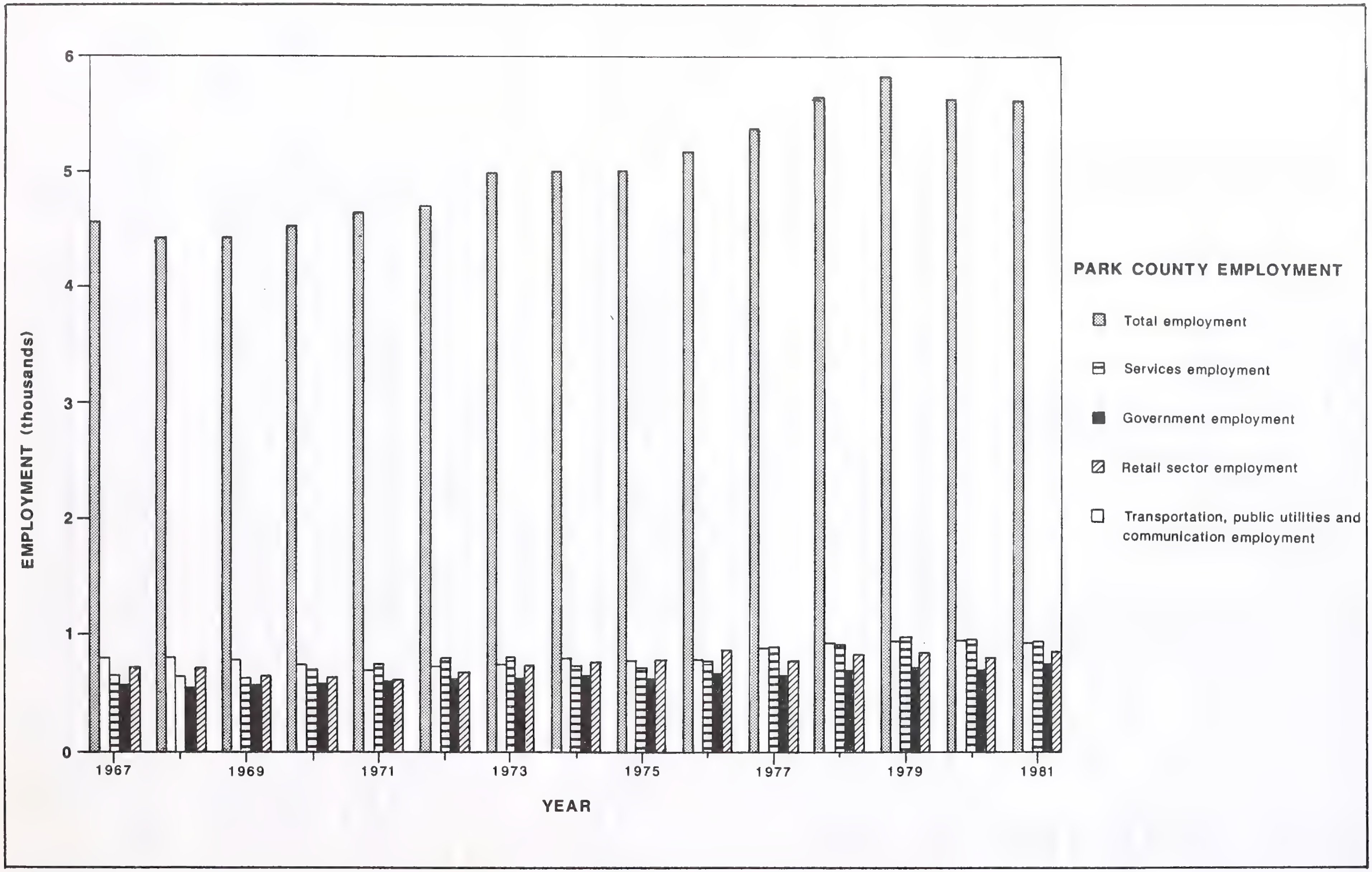


Figure II-27: The employment picture for Park County from 1967 to 1981 is displayed here graphically.

About 53 basic industry jobs were lost in the agricultural sector of Park County from 1970 to 1982. The number of nonbasic (derivative) jobs that serve the agricultural sector also declined over that period (see appendix 9).

Other sectors of employment--particularly those related to tourism--have been more stable. The service sector is the largest employer, providing about 17 percent of total Park County employment in 1982. Employment in this sector has remained fairly constant from 1978 to 1982 and has recovered more quickly from the recession than employment in other sectors. The 1982 level of employment in the service sector is only 10 jobs fewer than the pre-recession high in 1979 of 966 jobs.

Retail trade, the second largest employer in Park County, grew from 648 jobs in 1970 to a peak of 860 in 1976. During the recession, the number of jobs in the retail trade sector declined to 782 in 1980, about 12 percent below the 1979 level of 830. Retail trade employment stood at 812 jobs in 1982.

Neither the economy of Montana nor Park County has regained pre-recession peak levels of employment. Forecasts for the state predict that the Montana economy should improve to a level equal to its pre-recession peak by late 1985 (Economics Montana, March, 1985, p.1). The Park County economy should also improve, although more slowly than the state economy. County employment will continue to have the strongest recovery in the retail trade and service sectors. However, employment in the transportation and public utilities sector will not regain historic high levels due to closure of the BN repair shop.

Park County Unemployment

Park County unemployment has ranged from a low of 5.3 percent annually to 10.8 percent over the period 1976 to 1984 (see table II-21). Over that time period, county unemployment rates were higher than the state average for all but two years. Annual unemployment in Park County peaked in 1982 and declined through 1984, following the state trend as economic conditions slowly improved. Preliminary quarterly data for 1985 show monthly unemployment rates above the 1984 annual average; however, summer employment opportunities will offset first quarter statistics and the annual 1985 employment rate will probably be below that of the first quarter.

Table II-22 shows the number of job applicants by selected skills who applied for work through the job service in Park County for April 1983 and 1985 and November 1983. The active number of job applicants increased between 1983 and 1985. However, if the clerical skill category is subtracted, the number of job applicants remained nearly constant. Although the total number of applicants remained constant, the types of skilled applicants changed over that time period. Job applicants with clerical skills increased the most, from 83 to 111. Applicants listed together as sawmill workers and loggers increased from 25 to 42. The number of general laborer and machinist job applicants declined from 105 to 61.

Table II-21: Park County and Montana Unemployment Rates

Year	Park County (percentage)	Montana (percentage)
First Quarter 1985 (unrevised)		
March	9.6	8.0
February	9.3	8.4
January	11.1	9.2
1984	8.6	7.4
1983	10.6	8.8
1982	10.8	8.6
1981	8.3	6.9
1980	7.1	6.1
1979	5.3	5.1
1978	5.8	6.2
1977	6.6	6.4
1976	5.4	6.1

Source: Montana Department of Labor and Industry, First Quarter 1985, pp. 15-17 and 28-36.

Table II-22: Number of Park County Job Applicants by Selected Skills

Skill Category	Job applicants April 1983[1]	Job applicants November 1983[1]	Job applicants (April 1985)[2]		Job applicants 55 and over (April 1985)[2]	
			Active	Inactive	Active	Inactive
Machinists	10	2	5	3	0	2
Auto mechanic	16	18	24	35	1	1
Diesel mechanic	15	10	14	12	1	3
Electrician	5	4	7	13	0	1
Carpenter	29	8	39	44	1	2
Pipefitters/plumbers	5	4	4	10	0	0
Equipment operators	12	8	13	31	0	2
General laborer	95	52	56	102	0	1
Clerical workers	95	52	111	243	15	2
Sawmill workers	20	31	27	42	1	1
Loggers	5	4	15	13	0	1
Assemblers (mining machinery)	2	0	0	1	0	0
TOTAL	297	191	315	549	19	16
Total less clerical applicants	214	141	204	306	4	14

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[1] Mountain International, August 1984, p. 35.

[2] Dale Siegle, Manager, Livingston Branch, Job Service Division, Montana Department of Labor and Industry, pers. comm., April 19, 1985.

Employment

Barring another national business downturn or recession, Park County employment should show moderate gains after the county economy adjusts to closure of the BN shop. Employment between 1967 and 1982 grew at annual rates up to 4.8 percent; however, during the recent recession annual employment declined at rates up to 3.3 percent. The total annual average change in employment from 1967 to 1982 was 1.3 percent.

A modest steady growth in employment is forecast for Park County (see table II-23). Most of the growth will occur in the retail trade and services sectors, emphasizing the importance of tourism to county employment.

Table II-23: Projected Park County Employment (without the Jardine Joint Venture Project)

	Year							
Employment	1980 census	1982 BEA data	1985	1990	1995	2000	2005	2010
Total employment	5,631	5,536	5,643	6,079	6,548	7,054	7,599	8,186

Source: Department of State Lands, unpublished working papers, February 1986.

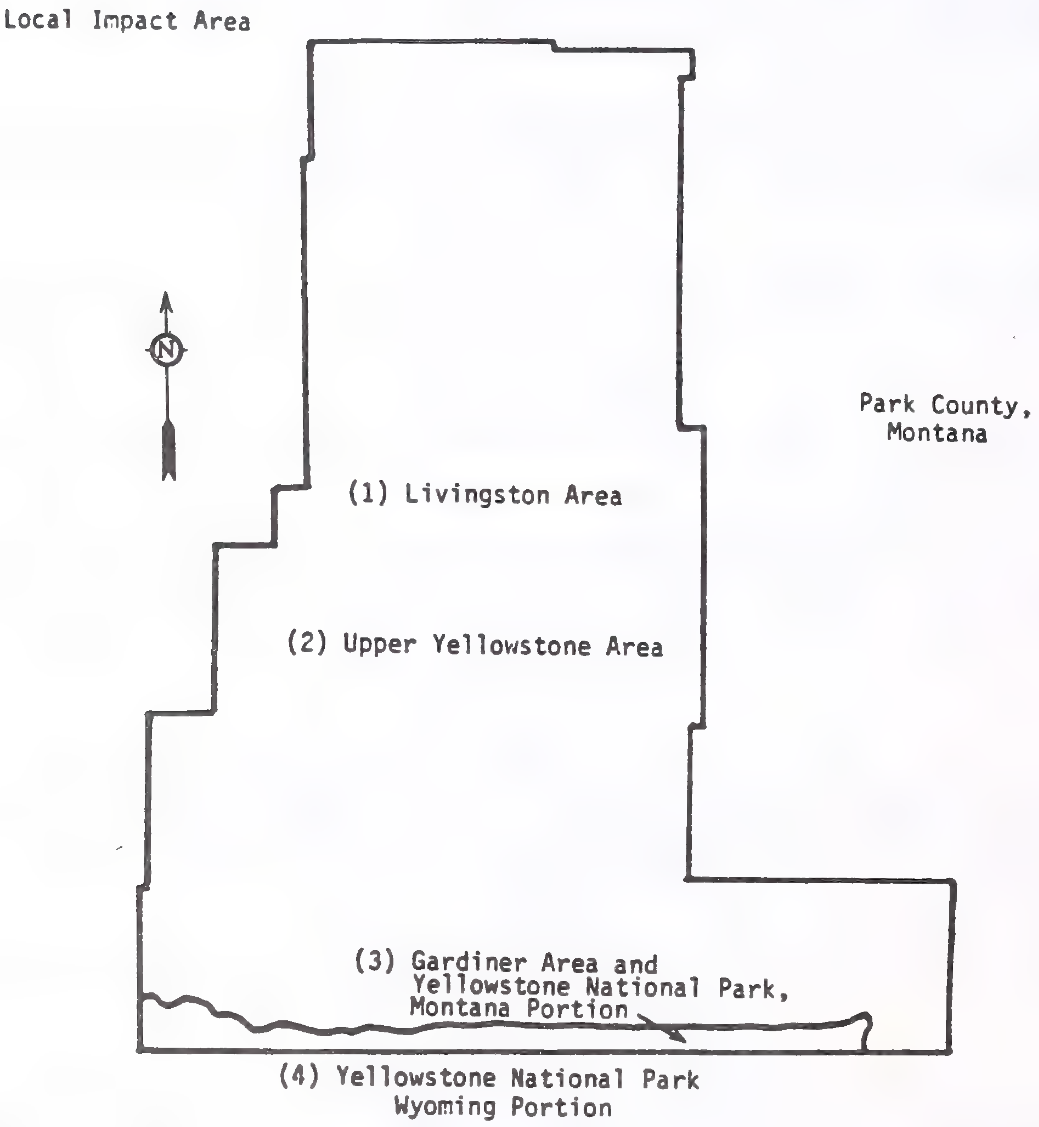
Assumptions: Historical growth rates (1967-1982) were used to project employment. Values after 1985 reflect employment declines due to closure of the BN shop in Livingston.

Total employment is projected to increase about 48 percent from 5,536 jobs in 1982 to 7,251 in 2010. Such growth could be too optimistic if the nation slides into another recession or the county recovers from the BN shop closure more slowly than anticipated.

SOCIOLOGY

Demography, social life, and community services each contributes to the sociological scenario of Park County. The proposed project would affect residents in the southern part of the county more substantially than those in the remainder of the county. For purposes of this study, the local impact area will be defined as Park County. The city of Livingston, the Upper Yellowstone Census Division (Paradise Valley), the Gardiner, Cooke City, Yellowstone National Park (Montana portion) Census Divisions, and Yellowstone National Park (Wyoming portion) each will be considered sub-units of the impact area. Existing demographic patterns together with potential impacts will be presented where data exist. The remainder of the county will be treated as one area because the development impact would be minimal. Figure II-28 illustrates the local study areas in Park County.

The Wyoming portion of Yellowstone National Park includes that area north of Yellowstone Lake in Park County, Wyoming, to the Montana border including the community of Mammoth. The close proximity of Mammoth to the Gardiner area and the functional relationship that Mammoth has to the Gardiner demographic/


Local Impact Area
N
Park County, Montana
(1) Livingston Area
(2) Upper Yellowstone Area
(3) Gardiner Area and Yellowstone National Park, Montana Portion
(4) Yellowstone National Park Wyoming Portion

(1) Livingston Area includes the incorporated town of Livingston.

(2) Upper Yellowstone Area includes the Upper Yellowstone Census Division without Livingston.

(3) Gardiner Area includes the Gardiner - Cooke City Census Division and Yellowstone National Park, Montana Portion.

(4) Yellowstone National Park, Wyoming Portion, includes the community of Mammoth (1980 Census reported 425 persons for the area).

Figure II-28: The local sociological impact areas were divided into three sections of Park County, and one area in northern Yellowstone National Park in Wyoming.

economic environment warrants including this region in the local study area. In 1980, the Yellowstone National Park Census Division in Park County, Wyoming, had 425 inhabitants, about 400 of whom lived in the community of Mammoth, Wyoming. The Gardiner Area Census Division is combined with that portion of Yellowstone National Park in Montana because about half of the 66 residents (1980 census) in this portion of Yellowstone Park actually reside within the park boundaries next to Gardiner (Tom Swan, manager, Administrative Services, National Park Service, Mammoth, Wyoming, pers. comm., May 1985).

Livingston is the major trade center in Park County and over half of the county population resides there. Clyde Park is the only other incorporated community in Park County, but because it is located about 30 miles north of Livingston, it will not be considered as a separate entity in this study.

Demography for Park County

In 1980, the U.S. Bureau of the Census reported the population of Park County at 12,869 people, up 15 percent over the 1970 census. The population of Park County has fluctuated little since 1910, peaking in 1960 at 13,168 people. Since 1980, the population has increased slightly. Table II-24 illustrates current population estimates and components of change for Park County from 1980 through 1984.

Table II-24: Estimated Population and Component Changes for Park County, Montana

Year	Population	Actual births	Actual deaths	Estimated migration
1980	12,869	--	--	--
1981	13,300	219	125	337
1982	13,200	206	133	-173
1983	13,300	179	150	71
1984	13,400	211	143	32

Sources: U.S. Department of Commerce, Bureau of the Census, Local Population Estimates, Series P-26, No. 84-52-C, March 1985. Montana Department of Health and Environmental Sciences, Vital Records and Statistics Bureau, Annual Reports.

The population estimates presented in table II-24 are prepared annually by the Bureau of the Census and the Bureau of Business and Economic Research, University of Montana. These estimates are based on county births, deaths, school enrollment, federal income tax returns, and Medicare data. As illustrated, the estimates show an initial increase in 1981 and a stable population base since that time. Park County has experienced a declining economic environment since 1980 (primarily because of the reduction of the Burlington Northern labor force). However, the population has remained fairly constant through 1985 because enough people move into the area to offset those who may move out due to the economic environment. DSL expects that the recent population decline because of the BN shop closure will cause a reduction in total population over the next few years.

The most obvious population influx is associated with the Church Universal and Triumphant. About 200 to 300 people associated with the church have moved into Park County since 1980 (Andy Epple, Park County Planner, pers. comm., May 1985; Ed Francis, President, Royal Teton Ltd./Church Universal and Triumphant, pers. comm., May 1985). Other influx has probably occurred because of retirement and relocation due to the appealing, natural environment. This type of growth in the Upper Yellowstone Valley is an extension of the 1970-1980 growth for the area when the population increased about 10 percent with little or no change in the economic base.

The population density of Park County is 4.8 persons per square mile (1980 census), somewhat lower than the state density of 5.4 persons per square mile. The percentage of urban population (those living in incorporated places) in Park County is about the same as the state average of 53 percent. In 1980, 98 percent of the Park County population was classified as white and the median age was about 34 years for females and 32 years for males.

The number of households in Park County in 1980 was 4,924, with an average household size of 2.54 persons. This average is a slight decrease from the 1970 size of 2.8 and is significantly smaller than the 1980 average state household size of 3.1 persons.

Residents of Park County approach the state norm in education, with 75 percent of the people completing 12 years or more of school. The percentage of county residents completing 16 years of more of school is about 14 percent, slightly lower than the state average of 17.5 percent.

Demography for Park County Communities

From 1910 to 1970, the population of Livingston fluctuated in much the same manner as the county. However, from 1970 to 1980, while Park County grew nearly 15 percent, the population of Livingston increased only 2 percent. Table II-25 illustrates the past growth and current trends from 1980 to 1984.

As shown in table II-25, nearly all of the growth from 1970 to 1980 within Park County occurred in the Upper Yellowstone Census Division and in the Gardiner area. The 1984 estimates were calculated using extensions of this growth and were controlled by the county total estimate illustrated in table II-24. The 1980-84 Gardiner area growth is entirely attributable to members of the Church Universal and Triumphant moving into the area.

Selected demographic characteristics for local communities within the study area are presented in table II-26. Within Park County, the average household size ranges from 2.79 in the Upper Yellowstone Valley to 2.34 in the Gardiner area. Both the Gardiner and Upper Yellowstone areas have a smaller proportion of people over the age of 65 than does Livingston. The median age in these 2 areas is 3 to 4 years younger than Livingston. The median family income for all areas in Park County is nearly the same; however, this data is based on a 20 percent sample of the 1980 census.

Table II-25: Local Area Population Estimates for the Jardine Study Area

Place	Census 1970	Census 1980	Estimated 1984	Percentage change 1980-84
Park County	11,197	12,869	13,400	4.1
Livingston	6,883	6,994	7,150	2.2
Gardiner Area	909	1,135	1,250	10.1
Upper Yellowstone Area	1,661	3,335	3,550	9.4
Remainder of County	1,808	1,471	1,450	-1.5
YNP/Wyoming[1]	400	425	425	0

[1] Note: Yellowstone National Park/Wyoming includes Mammoth with an estimated 1980 population of 400.

Table II-26: Selected Demographic Characteristics of the Jardine Study Area (1980 Census)

Characteristic	Park County	Livingston	Upper Yellowstone	Gardiner area
Households	4,924	2,843	1,197	485
Persons per household	2.54	2.41	2.79	2.34
Age characteristics:				
Percent				
Under 18	26.8	25.2	30.4	23.1
18-64	58.7	56.8	60.3	66.4
65 and over	14.5	18.0	9.3	10.5
Median age	32.7	34.4	30.0	31.3
Median family income	$18,042	$18,852	$19,040	$18,688

Source: U.S. Census Bureau, 1980.

Note: The Gardiner area statistics are a weighted average of the Gardiner-Cooke City Census Division and Yellowstone National Park Division (Montana portion).

Population Projections

The population of Park County is estimated to increase about 2.3 percent over the next 10 years and 8.0 percent over the next 20 years (see table II-27). These projections are consistent with those developed by the Census and Economic Information Center, Montana Department of Commerce (13,900 in 1990 and 14,700 in 2000). Estimates in table II-27 and those of the Census and Economic Information Center are 300 to 500 persons higher than baseline projections published in the Jardine Joint Venture (JJV) Mitigation Plan (Mountain International, Inc., 1984). However, the annual county growth rates associated with that set of projections are consistent with the growth rates in table II-27. The major difference between JJV mitigation plan projections

Table II-27: Baseline Population Projections for Local Impact Areas in Park County[1]

Year	Park County and YNP Wyoming	Livingston	Upper Yellowstone	Gardiner area	YNP Wyoming
1980	12,869	6,994	3,335	1,135	425
1984	13,400	7,150	3,650	1,250	425
Projections					
1985[2]	13,200	7,050	3,500	1,300	145
1990[3]	13,150	6,675	3,750	1,350	425
1995	13,500	6,725	4,000	1,400	425
2000	13,900	6,775	4,250	1,450	425
2005	14,250	6,875	4,500	1,500	425
2010	14,650	6,925	4,800	1,550	425

Note: The Shields Valley Division (not shown) is forecast to remain at the same level over the projection period.

[1] The baseline (without project) projections are the product of a demographic/economic simulation model that uses projected labor force participation by age and sex rates and cohort survival techniques of county population by 5-year intervals to the year 2010. Cohort survival refers to the estimated mortality rates of persons by age category. For example, statistically, persons 20 to 30 years old are more likely to survive an additional year than persons aged 60 to 70. As illustrated, the projections represent an annualized growth rate of about 1 percent--equal to stable or no growth scenario.

[2] The 1984-85 decrease for Livingston and Park County reflects the expected out-migration related to the current economic environment.

[3] Population estimates reflect the effect of the BN shop closure in Livingston.

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and the other two is that the JJV plan assumes that a higher number of unemployed workers will leave Park County in search of work than do the other two forecasts.

The baseline projections produced for the sub-county areas use the 1980 distribution of population in Park County and the 1970-80 area growth rates. These local area projections are calibrated according to 1984 population estimates and projected county totals.

Social Life

(Information on social life was taken predominantly from the Social Life sections in Volumes I and II of the socioeconomic reports prepared for the JJV Hard Rock Impact Mitigation Plan by Mountain International, Inc. [1984].)

Mining began in southern Park County in 1866, when gold was discovered in Bear Creek near the present site of Gardiner. In 1880, a post office was established at Gardiner. The Bear Gulch Company opened the Jardine Mine in 1899. Gardiner became a primary gateway to Yellowstone Park, the outfitting point for the mines in Bear and Crevice gulches, and the commercial center for southern Park County.

The construction of the Northern Pacific Railroad and the creation of Yellowstone National Park shaped the history of Park County, and the Gardiner area in particular. The railroad created the city of Livingston, which remains the county seat and the largest community in Park County. The railroad has been the largest single employer in Park County since it entered the county in 1882. Gardiner has depended on the Park and the tourism it generates.

Survey Methods. In 1981, individuals in 204 households were surveyed by interviewers using a questionnaire designed to learn opinions regarding the nature and quality of life in the study area. Surveyed households were selected at random to assure the survey respondents were representative of area residents. The area surveyed approximated the combined Gardiner and Mammoth elementary school districts. It included Mammoth and Gardiner communities plus the rural areas east, west, and north of Gardiner incorporating Jardine, Tom Miner Basin, Cinnabar Basin, and households along Highway 89 to Point of Rocks. All households along the Jardine Road from the edge of Gardiner to the proposed minesite were included in the survey because residents of the area live near the proposed project.

In April 1985, additional interviews were conducted in the Gardiner area and Livingston to learn about the concerns associated with the Jardine Joint Venture Project. Interviews were held with the Park County Commissioners, Park County Planning Board, the Gardiner Chamber of Commerce, members of the former Gardiner Area Planning Advisory Group, the Bear Creek Council, local business people, the Park County Sheriff, Park County Planner, and Gardiner School Superintendent.

The residents surveyed in 1981 ranked characteristics of the area they liked best from a list of 16 choices; nearly all the survey participants ranked the natural environment as the best. They ranked the other top characteristics in the following order: slow-paced life; friendliness of residents; quiet, solitude, and privacy; and sparse population. All surveyed Jardine residents rated quiet, solitude, and privacy very high (Mountain International, Inc., 1985, unpublished survey data).

Mammoth residents ranked recreational opportunities higher than other residents, placing it as the second most important characteristic. Most Mammoth residents do not intend to stay in the area permanently, whereas most Gardiner area residents plan to remain the rest of their lives.

When interviewed in 1981, area informants identified three traits characteristic of the Gardiner area--appreciation of the natural environment, individualism and self-sufficiency, and economic security. The importance of the natural environment involves three themes: appreciation of the grandeur, beauty, and bounty of the region; recognition of the importance of the natural environment in creating and sustaining the local economy; and use of the natural environment both as a source of direct sustenance (for example, firewood and game meat) and for recreation.

In Gardiner, work is performed to allow families to sustain themselves and maintain residences in the area and not necessarily to obtain a high standard of material living. Many Gardiner area residents are employed in seasonal jobs; a large number combine work in Yellowstone National Park with odd jobs for other public and private employers, and subsistence activities to make a living. By contrast, Mammoth residents typically are employed full time and are career-oriented. Good-paying, full-time jobs are rare and desirable in Gardiner.

There is a strong conservation ethic in the Gardiner area and an expectation that a developer be both sensitive to environmental considerations and a steward of the land. There is a difference, however, between Gardiner and Mammoth residents' attitudes in the way in which the resources of the natural environment are to be enjoyed. Gardiner residents generally have a more utilitarian view, seeing the natural environment as a resource to be harvested, though with respect. Mammoth residents exhibit a more preservationist view.

Social Structure and Interaction. Gardiner area survey respondents generally described Gardiner as an aggregate of many social groups, with interaction between individuals of the different social groups being casual and informal. Local groups and businesses have little power in the Gardiner area because the business community and major employers are almost completely from outside the area. Gardiner is not incorporated, and many decisions regarding the community are made by the Park County government.

There are several sources of discord among Gardiner area residents. Some conflict arises between residents of Gardiner and Mammoth regarding the appropriate use of the natural environment. Some conflict also exists depending on residents' opinions regarding the project. Divisiveness also occurs due to residents' attitudes regarding the Church Universal and Triumphant.

Social Institutions: Economic Life. The majority of residents surveyed described the Gardiner economy as stable. It is based on the maintenance of and tourism generated by Yellowstone National Park. The federal government is the primary employer in the Gardiner area and also controls most of the area land base. In addition, many Gardiner businesses are operated by absentee owners who generally participate in the community only during the summer. The primary source of income other than government employment is tourist spending. Four factors shape the Gardiner area economy: seasonal cycles based on a four-month tourist season; service sector employment; extra-local influences; and constraints on economic development from the geography, climate, and transportation system of the area.

The Gardiner economy is influenced heavily by outside control. Except for the school system and a few businesses, all economic activity is either directed toward tourists or is generated by institutions with a regional or national orientation. This extra-local orientation of the economy appears to be a source of community tension. Some Park County residents are also concerned about the economic power of the Church Universal and Triumphant because it does not depend on the region economy.

Social Problems. Alcohol abuse was considered the most common social problem in the Gardiner area when research was conducted in 1981. Teenage drinking was identified as the second most prevalent social problem locally, while traffic offenses ranked third and divorce fourth. Drug abuse, although ranked fifth, does not appear to be a particularly significant problem among the county's indigenous population, according to survey respondents.

Crime ranked eighth in prevalence of the 10 social problems residents were asked about in 1981. The Park County rate of felonies has generally been below the state average. Felonious criminal activity was regarded as rare in the immediate Gardiner area during the winter months except for antler collecting, which refers to removing antlers from Yellowstone National Park. People hunting antlers sometimes poach big game or destroy wildlife to obtain the antlers. In the summer, criminal activity increases with the arrival of seasonal workers and tourists. Crimes committed during the summer are typically disturbances, drug offenses, and theft.

Attitudes and Concerns. When area residents were surveyed in 1981, they were asked how they felt about outsiders moving into the area. The majority (52 percent) of the residents of Gardiner, Jardine, and the other rural areas near Gardiner said they would not mind, 23 percent said they would welcome them, and 23 percent said they would prefer not to have them. In Mammoth, 57 percent said they would welcome outsiders, 30 percent said they would not mind, and 11 percent said they would prefer not to have them (Mountain International, Inc., 1985, unpublished survey data).

Community Services

Community services provided by Park County, the National Park Service, and the municipalities of Livingston and Gardiner would be the most likely to be affected by the proposed project. The following community services currently exist in the study area and would probably be more heavily used with construction and operation of the proposed project.

Education. Projected school enrollment between 1984 and 1990 for Park County as a whole is expected to increase by about 151 students in all grades without the proposed project (Mountain International, Inc., 1984, vol. III, p. 33). Livingston, over the last five years, has enrolled about 70 percent of all the elementary and middle school students in Park County and about 78 percent of the secondary students of the county (Mountain International, Inc., 1984, vol. III, p. 28). Future trends in student enrollment in Livingston, as compared to Park County as a whole, are not expected to change significantly.

Schools in the Gardiner area are the Gardiner Elementary School, and the elementary schools in Mammoth, Wyoming (Yellowstone National Park), and Cooke City, Montana. The Gardiner High School was destroyed by fire in late 1985. Enrollment in the 1982-83 school year was 119 in the Gardiner Elementary School and 88 in the high school (Mountain International, Inc., 1984, vol. I, p. 165). High school students have been attending classes in Mammoth, Wyoming. The county plans to reconstruct the high school. The date of reconstruction and plans have not been decided (Andy Epple, Park County Planner, pers. comm., January 23, 1986).

Between 1984 and 1990, enrollment is expected to gradually increase in grades K through 6 by about 15 students and decrease in grades 7 and 8 by about 10 students. High school enrollment is projected to reach a peak in 1985-86, and decline by about 46 students by 1990 (John Fitzpatrick, Consultant, Mountain International, Inc., pers. comm., April 17, 1985). An increase in elementary enrollment by 80 students would reach the functional capacity of the school, while the high school could accommodate another 20 to 25 students without additional teachers and curriculum modifications (Mountain International, Inc., 1984, vol. I, pp. 167-168).

Education in Livingston is provided by 3 elementary schools, 1 middle school, a Catholic parochial elementary school, 1 high school, and a special education center. Based on 1982-83 classroom configurations, the Livingston elementary schools could accommodate an additional 159 students in grades 1 through 5 and the high school and middle school could each facilitate 200 more students with the addition of the necessary teaching and support staff (Mountain International, Inc., 1984, vol. III, pp. 30-31). High school students from Springdale, Richland, Pine Creek, and Arrowhead school districts attend school in Livingston (John Overstreet, principal, Gardiner Public School, pers. comm., May 1985).

Schools in Park County, other than those in Livingston and Gardiner, that could be affected by the proposed project are three rural elementary schools in the Upper Yellowstone Valley (Arrowhead, Pine Creek, and Richland). Present (May 1985) school enrollment is 14 students at Richland, 27 students at Pine Creek, and 51 students at Arrowhead. Due to a decrease in enrollment at Richland and Arrowhead schools, a teacher at each school will be laid off at the end of this school year (Sonja Spannring, Park County Superintendent of Schools, pers. comm., May 1985). Depending on the location of in-migrating mine employees and the number and age of their children, these schools could accommodate an increase in enrollment.

Law Enforcement. Law enforcement services in Park County are provided by the Montana Highway Patrol, the Park County sheriff's department, the National Park Service, and the Livingston police department. Three state highway patrol officers are based in Livingston and patrol the major roads and highways in Park County and adjacent areas. The sheriff's department serves the rural areas including Gardiner, Cooke City, Clyde Park, and Wilsall. The jurisdiction of the Livingston police is confined to the city limits of Livingston. National Park Service Rangers patrol Yellowstone Park and a portion of Gardiner lying within the legal boundary of the park.

Of the total equivalent of 8.0 full-time officers, the Park County sheriff's department has 2 deputies stationed year-round in Gardiner (Dennis Frawley, Park County undersheriff, pers. comm., February 14, 1986). Additional special deputies can be activated as necessary from a support pool of six reserve officers (park rangers). Although there are no formal agreements between the National Park Service and the sheriff's department, both groups work together and coordinate activities to mutual benefit.

The county sheriff and other citizens believe that another deputy is needed in Gardiner at the present time (Bob Oakland, Park County sheriff; Gardiner Chamber of Commerce; Dave Schreiber, member, Gardiner Concerned Citizens; Park County Planning Board, all pers. comm., April 1985). In a 1981 survey conducted by Mountain International, 77 of the 111 Gardiner respondents thought that the police services were poor. However, no qualitative judgement regarding the workload of Park County officers can be determined from such statistics.

The Livingston police department has a full-time staff of 10 officers, and shares office, dispatch, and jail facilities in the City-County Municipal Building with the sheriff's department. Eight of the 10 officers are assigned to street patrol on a regular basis (Bonnie Waters, dispatcher, Livingston police department, pers. comm., May 1985).

Fire Protection. There are five rural fire districts in Park County (Livingston, Cooke City, Clyde Park, Wilsall, and Gardiner). Presently, the county is trying to form two more districts so that the entire area from Livingston to Gardiner would be covered (Carlo Cieri, Park County commissioner, pers. comm., May 1985).

Ten paid firefighters, backed up by 12 volunteers, provide 24-hour fire protection for the city of Livingston. The fire department currently owns 3 pumper trucks (1 with an 85-foot ladder), 1 rescue van, 1 pickup with a monitor, more than 3,000 feet of hose, extractive equipment, smoke ejector units, and portable breathing apparatuses (David Frederick, firefighter, Livingston fire department, pers. comm., May 1985). Although the fire department primarily serves the city of Livingston, it also provides support service for rural Park County, Big Timber, and Yellowstone National Park. On a scale from 1 to 10 with Class 1 being the highest rating, the present fire protection rating is Class 7 (Earl Huestis, field representative, Insurance Service Organization, pers. comm., May 1985).

Gardiner is served by 15 to 25 volunteer firefighters (Gene Kremer, Gardiner volunteer firefighter, pers. comm., April 1985). The fire department has three fire engines with capacities of 750 gallons, 500 gallons, and 300 gallons (Mountain International, Inc., 1984, Mitigation Plan, pp. 95-96). The department has a Class 7 fire protection rating (Earl Huestis, field representative, Insurance Service Organization, pers. comm., May 1985).

Additional rural protection is provided by the Gallatin National Forest, the National Park Service, and the Department of State Lands Forestry Division. The National Park Service houses fire protection equipment at Mammoth to provide service throughout Yellowstone National Park including the warehouse/shop compound located at Gardiner (Mountain International, Inc., 1984, Mitigation Plan, p. 95).

Ambulance. Ambulance services in the Gardiner area are provided by 10 volunteers (2 of whom are certified emergency medical technicians) affiliated with the volunteer fire department. The radio-equipped ambulance is a 1972 van modified and equipped to provide emergency medical aid. Fees for services and donations pay for the ambulance and emergency services (Mountain International, Inc., 1984, Mitigation Plan, p. 122).

The average number of emergency calls answered annually by the Gardiner ambulance is between 25 and 35 (Gene Kremer, Gardiner volunteer firefighter, pers. comm., April 1985). In a 1981 survey conducted by Mountain International, 85 of the 111 Gardiner respondents rated the ambulance service as moderate, good, or excellent.

Yellowstone National Park has 2 ambulances and 9 to 10 Park Service personnel stationed at Mammoth who provide emergency services. Although the Park Service emergency services are funded for primary use within the Park, aid is provided outside the park boundary in response to major emergencies or when the Gardiner ambulance is not available (Mountain International, Inc., 1984, Mitigation Plan, p. 122).

A private ambulance firm (Community Lifeline), operating three ambulances, serves Park County and has a contract with Yellowstone National Park to provide emergency services. The company employs 15 persons (five emergency medical technicians and the remainder advanced first aid, six-month probation people) (Mark Christensen, owner, Community Lifeline, pers. comm., May 1985). Fixed-wing aircraft and helicopters, operated by Saint Vincent and Deaconess hospitals in Billings, provide air ambulance service throughout Park County (Mountain International, Inc., 1984, vol. I, p. 189).

Hospital and Medical Personnel. The Livingston Memorial Hospital, a 54-bed acute care facility staffed by 100 to 115 full-time employees, is the only hospital in Park County and adjacent Yellowstone Park. As of February 1985, there were 15 active physicians (including 1 pathologist, 1 radiologist, and a few Bozeman doctors) associated with the hospital, 26 full-time registered nursing positions, 3.5 full-time license practical nursing positions, and 1.5 full-time pharmacist positions (Jacqueline McKnight, Chief, Licensing and Certification Bureau, Montana Department of Health and Environmental Sciences, pers. comm., May 1985). The existing number of medical staff are considered to be adequate; however, with or without the project, the physical facility should be replaced (Richard Brown, Administrator, Livingston Memorial Hospital, pers. comm., May 1985). In 1980, the occupancy rate of the hospital was 42 percent (Mountain International, Inc., 1984, vol. I, p. 186). Presently, the hospital is not operating at capacity.

About 80 percent of the hospital patients were from Livingston in 1979, and 4 percent (about 52 patients) were from Gardiner. About 39 Gardiner patients also used the Bozeman Deaconess Hospital in 1979 (Mountain International, Inc., 1984, vol. I, pp. 185-186).

No physicians reside in the Gardiner area (Park County Commissioners, pers. comm., April 1985). The city of Livingston, however, has a total of 10 doctors--1 at the Livingston Clinic, 1 at the Yellowstone River Family Medical Center, 7 at the Park Clinic, and 1 independent (Betty Fischer, receptionist, Livingston Clinic, pers. comm., May 1985; Melva McCure, file clerk, Park Clinic, pers. comm., May 1985).

A medical clinic, owned by the National Park Service, is operated during the summer tourist season in Mammoth (Mountain International, Inc., 1984, vol. I, p. 186). The facility is staffed by a physician's assistant, a registered nurse, and a secretary. It is equipped to handle emergencies and short-term care on a limited basis (i.e., 1 room for short-term observation/stabilization) (Mountain International, Inc., 1984, vol. I, p. 186).

Water Supply. Public water supplies for Livingston and Gardiner are obtained from either ground water, the Yellowstone River, or both. Gardiner's primary water source at present is a 225- to 250-gallon per minute (gpm) spring and the secondary source is a 350-gpm pumping and treatment facility on the Yellowstone River. The development of new wells (500-gpm projected capacity) is underway to provide a new laundry complex in Yellowstone Park with water and a more reliable source of water for Gardiner.

Livingston has relied upon both pumped ground water and treated water from the Yellowstone River. In 1982, however, the Yellowstone River treatment plant was permanently closed. Currently, Livingston relies solely on wells and has experienced water shortages during the peak summer irrigation season (Jerry Burns, Water Quality Bureau, Montana Department of Health and Environmental Sciences, pers. comm., April 1985). The construction of new wells should be completed by 1986 and would thereby alleviate water shortages (John Connell, Engineer, Christian-Spring-Sielbach and Associates, pers. comm., April 1985).

Rural water supplies throughout Park County are predominantly private wells. It does not appear that the construction and operation of additional private wells would inhibit suburban development in the Upper Yellowstone Valley.

Water availability for fire protection in Gardiner currently meets the minimum standards promulgated by the National Board of Fire Underwriters, even during the peak periods of water consumption in August (Mountain International, Inc., 1984, Mitigation Plan, p. 100). With the development of new wells, adequate fire flows (a measurement of the capacity of a water system to provide water for firefighters) would be ensured.

Wastewater Treatment. Sewage facilities serving Gardiner and Mammoth, Wyoming, are composed of an aerated sewage lagoon system with chlorination units for treating effluent discharge from the lagoons. Because the facility is approaching the end of the designed 20-year life span and is in need of repair, the existing facility will have to be refurbished and expanded to adequately provide future service with or without the proposed project (Bill Enright, assistant office manager--Billings Office, Morrison-Maierle, Inc., pers. comm., April 1985). The additional demand imposed by the new laundry complex in Yellowstone Park would bring the system up to about 80 to 85 percent capacity (Dave Holland, operator, Gardiner Wastewater Treatment Plant, pers. comm., May 1985). Furthermore, addition of up to 75 families (or about 200 individuals) coupled with the new laundry could bring the system to capacity for reliability purposes (Bill Enright, assistant office manager--Billing Office, Morrison-Maierle, Inc., pers. comm., April 1985). The system capacity should be adequate until 2005, based on Gardiner population estimates (see table II-27).

The current Livingston wastewater treatment plant began operation in 1981 and presently is in a stable operational mode, producing a high-quality effluent. The facility serves a population of 9,000 with a designed capacity of 10,500 (Montana Department of Health and Environmental Sciences, Evaluation Report, April 17, 1984).

Solid Waste. Solid waste is collected and disposed of throughout Park County under the supervision of a county-wide disposal district (Mountain International, Inc., 1984, vol. I, pp. 203-04) and paid for by the users. Collection bins (green boxes) are situated in various locations throughout Livingston and the county where refuse is deposited by residents and collected by a truck mounted with a compactor. In Gardiner, there are 34 green boxes located in one spot. These boxes are surrounded by a chain link fence and have been "bear-proofed." Refuse is hauled to Livingston where it is burned in an incinerator. The National Park Service also collects solid waste from Yellowstone National Park and Cooke City and transports it to the Livingston incinerator for disposal.

Currently the incinerator burns about 50 to 60 tons per day with a capacity of 72 tons per day. The Park County landfill is used for disposal of metals (pig iron) and ash from the incinerator. An estimated 10 acres have been used with 30 acres still remaining (Ed Flatt, operator/manager, Park County Incinerator, pers. comm., May 1985).

Social Welfare. Social welfare programs in Park County are administered with funds coming from state, federal, and county sources. The social welfare programs offered through Park County include:

1) aid to families with dependent children,
2) medicaid and county medical assistance,
3) foster care,
4) food stamps,
5) social services,
6) general assistance,
7) transient assistance, and
8) visual services/vocational rehabilitation

The Park County Welfare Office is located in Livingston; Gardiner residents conduct business through the mail or drive to Livingston.

Housing. The number of available housing units for sale or rent in Gardiner is very limited. There are 7 or 8 homes listed for sale by 12 of the 13 Park County realtors and about 5 for sale by owners (Andy Epple, Park County planner, pers. comm., May 3, 1985).

Mobile home courts with facilities for year-round occupancy are nonexistent in the Gardiner area but there are three campgrounds--Rocky Mountain Campground and Paradise Campground in Gardiner, and Cinnabar Campground in Corwin Springs. The Rocky Mountain Campground has 13 permanent mobile home sites which are currently occupied; there are no plans to increase the number of available equipped lots (Bob Rucker, owner, Rocky Mountain Campground, pers. comm., May 1985). The other two campgrounds are designed for overnighters and there are no plans to add any permanent mobile home lots (Marsha Beese, owner, Cinnabar Campground, pers. comm., May 1985; Virginia Dowdy, owner, Paradise Campground, pers. comm., May 1985). The overnight trade produces more money and has fewer maintenance problems (Bob Rucker, owner, Rocky Mountain Campground, pers. comm., May 1985).

Small tract homesites near Gardiner that currently are for sale include:

1) about 10 small tract homesites in Gardiner (including four in the Sunny Slopes Subdivision),
2) about 40 undeveloped 20-acre tracts near Point of Rocks, and
3) more than 100 small undeveloped tracts in the Upper Yellowstone Valley.

In Livingston, there is an ample supply of relatively inexpensive housing available (Andy Epple, Park County Planner, pers. comm., May 3, 1985).

FISCAL CONDITIONS

Park County

Property tax revenues are the single largest source of revenue for Park County. Property taxes contributed 48.2 percent of total county general fund revenues in fiscal year 1983-1984 (FY84) and 37.7 percent in FY85. However, the percentages of property tax revenue to total revenue for Park County are below statewide averages for all counties, which were 49.8 percent in FY84 and 47.7 in FY85 (Montana Association of Counties, 1985). Growth in Park County revenues during the 1970s was due primarily to increases in intergovernmental transfers (Mountain International, Inc., 1984, vol. 1, p. 325).

Table II-28 shows Park County expenditures by major fund and the total for all funds for selected fiscal years between 1971 and 1985. The per capita expenditures from these funds are also listed by nominal dollars (not adjusted for inflation) and constant dollars adjusted for inflation to a 1980 base.

Nominal general fund spending has increased from $301,708 in FY71 to $1,043,162 in FY85, a 250 percent increase over 15 years. However, not all of the increase was due to real growth in expenses. Much of the increase was the result of inflation which caused governments to raise expenditures. The effect of inflation on general fund expenses is illustrated by comparing per capita general fund expenditures in nominal or current dollars and constant dollars that have been adjusted for inflation since 1980 (see table II-28). While nominal per capita, general fund expenditures more than tripled over the 15-year period ($26.95 in FY71 to $81.06 in FY85), real expenditures increased only 33 percent from $49.94 in FY71 to $66.38 in FY85.

General fund expenses accounted for almost half of total county expenditures in FY85. Together the road and bridge funds make up the second largest category, comprising nearly one-third of total FY85 expenditures. While nominal per capita expenditures for the Park County road and bridge funds more than doubled between 1971 and 1985, the real inflation-adjusted per capita expenditures varied between $31.00 and $40.00 over that time period (see table II-28).

The poor fund has been the third largest county expense since FY80. However, Park County recently opted for state assumption and control of county welfare programs. Under state assumption, a county must levy 13.5 mills for

Table II-28: Park County Expenditures by Major Fund, Selected Fiscal Years 1971-1985

Expenditure	1971	1975	1980	1982	1983	1984	1985
General fund							
Per capita expenditure[1]							
Nominal dollars	26.95	39.18	46.61	78.45	84.57	80.51	81.06
1980 dollars[2]	49.94	55.44	46.61	68.17	70.87	65.93	66.38
Mills	19.0	18.3	23.0	21.0	24.89	27.0	26.25
Total amount	301,708	438,704	599,771	1,009,520	1,088,356	1,036,046	1,043,162
Road and bridge funds							
Per capita expenditure[1]							
Nominal dollars	20.97	22.38	31.20	44.14	43.26	49.08	45.68
1980 dollars[2]	38.86	31.67	31.20	38.35	36.25	40.20	37.40
Mills	15.0	13.5	13.8	19.0	19.0	20.0	22.0
Total amount	234,820	250,596	401,480	568,088	556,659	631,757	587,869
Poor fund							
Per capita expenditure[1]							
Nominal dollars	9.07	7.51	8.19	16.53	15.97	7.19	1.43
1980 dollars[2]	16.81	10.63	8.19	14.36	13.38	5.89	1.17
Mills	7.0	3.0	5.5	9.14	8.65	2.5	10.36
Total amount	101,524	84,084	105,351	212,723	205,578	92,522	18,361
All funds[3]							
Per capita expenditure[1]							
Nominal dollars	61.39	79.51	119.04	165.52	170.39	181.62	167.30
1980 dollars[2]	113.76	112.51	119.04	143.83	142.79	148.72	136.99
Mills	44.37	42.46	51.81	59.60	63.63	73.70	79.38
Total amount	687,419	890,270	1,332,858	2,130,113	2,192,703	2,337,267	2,152,926

Sources: Montana Association of Counties, January, 1985. Montana Tax Foundation, Inc., 1985, p. 23. Mountain International, Inc., 1984, vol. 1 p. 309.

[1] Per capita expenditures for fiscal years 1970 and 1975 are based on the 1970 Park County population census count of 11,197. All other fiscal year per capita expenditures are based on the 1980 population census count of 12,869.

[2] Expenditures have been deflated using the implicit price deflator for state and local government expenditures, Survey of Current Business, July issues, 1975, 1977, 1979, 1982, and 1984.

[3] The total for all funds does not include the expenditures from the Planning, Hospital, Ag Extension, or Health and Sanitation Funds in fiscal years 1984 and 1985.

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the poor fund, and remit all poor fund revenues to the state. All poor fund expenses are paid by the state even if such amounts are above the revenues generated. Real per capita costs for the poor fund have ranged from $17.00 in FY71 to $1.17 in FY85.

Over the most recent five years, total county expenditures have remained fairly constant, varying from a low of $2.13 million in FY80 to a high of

$2.34 million in FY84. The current FY85 budget is $2.15 million. Total real per capita expenditures have ranged from $119.04 to $148.72 over the last five years.

The total taxable value of Park County has not kept pace with inflation over the period of 1972 to 1984 (see table II-29). While nominal growth (not adjusted for inflation) has averaged 2 percent annually from FY72 to FY85, real inflation-adjusted taxable valuation has declined from $24.68 million in FY72 to $15.03 million in FY85, slightly over 3 percent annually.

Statewide taxable valuation has kept pace with inflation although just barely. While the nominal value of total taxable value increased at an annual rate of 6.5 percent, inflation-adjusted, taxable valuation increased only 0.7 percent annually from 1972 to 1985 (see table II-29).

Mill levies in Park County and statewide have increased between FY70 and FY85. Inflation has driven up the cost of government services, while the real taxable value of property has declined. Mill levies have increased 44 percent statewide since 1970 due to these circumstances (Mountain International, 1984, vol. 1, p. 302). Mill levies in Park County have increased 79 percent from 44.37 mills in FY71 to 79.38 mills in FY85 (Montana Tax Association, 1985 and 1971).

Gardiner

Gardiner is not incorporated; therefore, it does not tax property or provide any government services. Special districts provide services such as fire protection, water supply, and street service. Such services could be assumed by Gardiner if it incorporated (Mountain International, Inc., 1984, vol. 1, p. 305). Several jurisdictions levy taxes on property in Gardiner. Table II-30 presents total mill levies imposed on property in Gardiner for selected fiscal years from 1970 to 1985.

Special district levies have fluctuated widely from a low of 51 mills in FY70 to a high of 397.50 mills in FY75. The 1975 levy was exceptionally high due to capital expenditures (Mountain International, Inc., 1984, vol. 1, p. 305). Total special district levies were 99.0 in FY85.

The county-wide school levy is the single largest levy on property in Gardiner (see table II-30). This levy includes the 40-mill county share of state equalization funds for the School Foundation Program and varied amounts for teacher retirement and transportation.

The county levy supports the general and special functions provided by the county. The statewide levy is a 6-mill tax which funds the University System.

School district mill levies have declined 8.2 percent between FY70 and FY85. This decrease occurred because the voted all-purpose levy for school operations was eliminated (Mountain International, Inc., 1984, vol. 1, p. 305).

Table II-29: Taxable Value of Park County and Montana for Fiscal Years 1972-1985 (in millions)

Fiscal	Park County		Montana	
Year	Nominal dollars	1980 dollars	Nominal dollars	1980 dollars
1985	$18.36	$15.03	$2,330.82	$1,908.59
1984	17.41	14.26	2,242.08	1,835.92
1983	17.83	14.94	2,204.49	1,847.40
1982	18.80	16.34	2,013.31	1,749.43
1981	19.13	17.61	1,845.01	1,697.98
1980	17.47	17.47	1,621.95	1,621.95
1979	16.43	18.10	1,568.29	1,727.53
1978	16.47	19.77	1,466.64	1,760.76
1977	16.27	20.91	1,391.94	1,788.64
1976	17.36	23.59	1,350.77	1,835.90
1975	16.18	22.89	1,198.51	1,695.92
1974	14.96	22.91	1,061.12	1,624.81
1973	14.24	24.16	995.10	1,688.00
1972	13.79	24.68	965.71	1,728.62
Average annual rate of change	2.06%	(-3.06%)	6.49%	0.7%

Sources: Montana Association of Counties, January 1985. Mountain International, Inc., 1984, vol. 1, p. 300. Survey of Current Business, July 1975, July 1977, July 1979, July 1982, and July 1984, gross national product implicit price deflator for state and local governments.

Gardiner School Districts

Gardiner has two school districts--elementary district #7 and high school district #4. Student grades 7 to 12 from Mammoth attend Gardiner schools. Payments in lieu of taxes (PILT) from the National Park Service cover educational costs for these students.

Table II-31 shows the elementary school district general fund budget and revenue sources by fiscal year from 1972 to 1983. The largest source of general fund revenue is the state School Foundation Program, accounting for 64.5 percent of the total district #7 budget in FY83.

The second largest source of district #7 revenue is the PILT from the federal government for students from Mammoth, Wyoming. In FY83, this payment amounted to 18.3 percent of the Gardiner elementary district budget. If payments for Mammoth students were not available, district levies would need to increase 93.1 mills in order to raise sufficient operating funds (Mountain International, Inc., 1984, vol. 1, p. 322).

District #7 general fund expenditures per regularly enrolled full-time student increased steadily when measured in nominal dollars (not adjusted for inflation) (see table II-31). Such spending increased 345 percent between FY72 and FY83. However, the average annual inflation rate in state and local

Table II-30: Gardiner Property Tax Mill Levies Selected Fiscal Years

Jurisdiction	1970	1975	1980	1982	1983	1984	1985
State	8.20	6.00	6.00	6.00	6.00	5.86	6.00
County	37.17	42.46	51.81	59.90	65.75	73.70	79.38
County-wide general school	50.37	52.48	68.85	77.25	83.19	97.66	95.67
School district	60.72	60.80	36.54	41.93	33.52	55.85	55.74
Special districts	51.00	397.50	75.04	109.36	126.07	90.14	109.00
Miscellaneous	.65	1.40	1.50	4.80	4.65	NA	NA
TOTAL	208.11	560.64	239.74	299.24	319.18	323.21	345.79
Average for communities under 500 population	188.70	195.96	231.51	239.04	246.17	285.68	292.19

Source: Montana Tax Foundation, 1983-1984 and 1985. Mountain International, Inc., 1984, vol. 1, p. 304.
NA means not available.

expenditures from 1972 to 1983 was 7.51 percent (Survey of Current Business, July 1975 and July 1984, implicit price deflator for state and local expenditures). Real or inflation-adjusted, per-pupil expenditures in the Gardiner elementary school increased from FY72 to FY76, decreased from FY76 to FY79, and then again increased from FY79 to FY83. Average annual growth in real per-pupil expenditures over that time was 7.1 percent. In spite of such growth, Gardiner elementary per-pupil expenditures are less than those of comparably sized school districts, and less than the statewide average for communities under 500 population ($2,756 per pupil 1982) (Mountain International, Inc., 1984, vol. 1, pp. 317-318).

Revenue and budget conditions for the Gardiner High School district #4 are similar to those for the elementary school district. Payments from the state School Foundation Program have been the major source of general fund revenues (see table II-32). Such revenues accounted for 71 percent of the FY83 budget, up from 51.5 percent in FY72.

The second largest source of revenue is federal PILT for the Mammoth, Wyoming students attending Gardiner High School. These revenues made up 20 percent of FY83 general fund revenues. Without the federal PILT, property tax levies would increase 65.5 mills in order to maintain the same level budget (Mountain International, Inc., 1984, vol. 1, p. 322).

Although nominal per-student expenditures have increased from FY72 to FY83, real (inflation-adjusted) spending has varied. The general trend in real per-pupil spending has been upward. However, in FY74, FY81, and FY83 average per-pupil expenditures fell below the level of the preceding fiscal year (see table II-32). Overall real inflation-adjusted, per-pupil expenditures for Gardiner High School have increased from $2,461 in FY72 to $3,323 in

Table II-31: Budget and Revenue Sources Gardiner Elementary School District #7 FY 1972 to 1983

	General fund revenue[1]				General fund budget per ANB			
Fiscal year	Foundation and permissive payments	Tuition[2]	Federal aid[3]	Other funds[4]	Total general fund budget	ANB[5]	Nominal dollars	1980 dollars
1983	$247,276	$70,000	$30,000	$35,378	$383,104	135	$2,838	$2,378
1982	240,528	62,500	20,500	10,590	334,118	139	2,404	2,089
1981	175,738	60,000	25,000	19,209	279,947	128	2,187	2,013
1980	172,990	40,000	25,000	31,986	269,976	142	1,901	1,901
1979	172,480	40,000	25,907	5,991	244,378	150	1,629	1,794
1978	142,494	40,000	32,491	-0-	214,985	137	1,569	1,884
1977	129,914	44,752	32,500	3,402	209,568	136	1,541	1,980
1976	119,246	52,299	38,000	7,658	217,203	139	1,563	2,124
1975	188,354	50,000	20,000	14,105	202,459	148	1,368	1,936
1974	78,649	36,506	20,000	-0-	135,155	140	965	1,478
1973	60,705	22,000	31,319	17,569	131,593	143	920	1,409
1972	60,281	28,978	27,000	3,848	120,107	146	822	1,117

Sources: Gardiner School District #7, Mountain International, Inc., 1984, vol. p. 317. Survey of Current Business, July issues of 1975, 1977, 1979, 1982, 1984, implicit price deflator for state and local government expenditures.

[1] FY70 was the last year that a district-voted levy was imposed. Since that year, there have been no revenues from a voted levy.

[2] Tuition includes 604 funds paid by National Park Service, categorized as tuition beginning in 1972.

[3] Federal Impact Assistance per Public Law 81-874.

[4] Includes cash reappropriations and state deficiency levy, 604 funds.

[5] ANB (average number belonging) means the average number of regularly enrolled, full-time pupils attending the public schools of a district.

Table II-32: Budget and Revenue Sources, Gardiner High School District #4 FY 1972 to 1983

	General fund revenue[1]				General fund budget per ANB			
Fiscal year	Foundation and permissive payments	Tuition[2]	Federal aid[3]	Other funds[4]	Total general fund budget	ANB[5]	Nominal dollars	1980 dollars
1983	$244,928	$70,000	$30,000	$ -0-	$344,928	87	$3,965	$3,323
1982	198,556	60,000	40,000	22,864	321,420	81	3,968	3,448
1981	169,733	65,000	39,164	9,450	283,347	85	3,333	3,067
1980	152,021	15,000	5,000	96,743	268,764	82	3,278	3,278
1979	140,409	15,083	9,124	63,308	227,924	NA	NA	NA
1978	135,638	40,000	20,000	30,911	226,548	90	2,517	3,022
1977	124,825	65,000	20,904	9,271	220,000	101	2,178	2,799
1976	113,552	48,040	54,000	7,270	222,863	110	2,026	2,754
1975	101,867	40,000	45,000	16,051	202,918	114	1,780	2,519
1974	105,735	36,924	24,971	-0-	167,630	116	1,445	2,213
1973	79,357	35,000	35,728	6,578	156,663	112	1,399	2,374
1972	73,715	-0-	35,000	34,310	143,025	104	1,375	2,461

Sources: Gardiner School District #4; Mountain International, Inc., 1984, vol. p. 317. Survey of Current Business, July issues of 1975, 1977, 1979, 1982, and 1984, implicit price deflator for state and local government expenditures.

[1] FY70 was the last year that a district-voted levy was imposed.

[2] Includes 604 funds (PILT) paid by National Park Service, categorized as tuition beginning in 1972.

[3] Federal Impact Assistance per Public Law 81-874.

[4] Includes cash reappropriations and state deficiency levy, 604 funds.

[5] ANB (average number belonging) means the average number of regularly enrolled, full-time pupils attending the public schools of a district.

NA means not available.

FY83, for an average annual increase of 2.85 percent. Although per-pupil spending has increased, Gardiner high school expenditures remain below those of comparably sized schools, and below the statewide average for communities with fewer than 500 people (Mountain International, Inc., 1984, vol. 1, p. 320).

The total mill levy assessed against Gardiner area property for the support of education in the state and county is shown in table II-33. In FY83, 123.51 mills was levied on property in Gardiner to support education.

The taxable value of property in the Gardiner school districts has not kept pace with inflation (see table II-34). The real value (adjusted for inflation) of taxable property in the elementary school district decreased 43 percent, while property in the high school district decreased 37 percent.

Gardiner Area Special Districts

There are three special districts in the Gardiner area providing fire protection, water supply and distribution, and sewage disposal (Mountain International, Inc., 1984, vol. 1, p. 323). None of the district budgets is large, and the taxable valuation of property within each district is small. District expenditures over the past decade have risen and fallen as capital improvements and equipment acquisitions have been undertaken; however, the general expenditure trend is upward.

Table II-35 shows the budgets of each special district for selected years. The fire and sewer districts are funded largely by property taxes, while the water district relies primarily on user fees.

Real inflation-adjusted expenditures have decreased for all districts from FY70 to FY80. Real revenues for the water and sewer districts also declined between FY75 and FY80. However, value of real-tax revenues received by the fire district increased between FY75 and FY80, and the FY80 revenues totalled more than FY70 revenues.

Fiscal Forecasts

Expenditures for Park County and both Gardiner school districts are expected to rise due to increases in population and the cost of service. Forecasts are based on results formulated by Mountain International, Inc., a consultant to the applicant; however, DSL altered those fiscal projections for Park County to reflect recent adjustments to census population counts for Park County. The assumptions of the forecast include: 1) four expenditure categories increase over the forecast period at the following rates--general government (2.7 percent), public safety (2.94 percent), public services (1.37 percent), and transportation (0.9 percent); 2) all other expenditure categories are assumed to remain constant; 3) existing indebtedness is paid according to schedule and is fully retired in FY93; and 4) no future debt service expenditures are estimated because there are no planned capital facility requirements (Mountain International, Inc., vol. 1, p. 328).

Table II-33: Property Tax Levies for Education Purposes Imposed on Gardiner Area Property FY83

Levy	Mills
Statewide	
University levy	6.00
County-wide	
General school	25.00
High school general	15.00
Transportation	4.62
Retirement	39.37
Gardiner Elementary District #7	
General (voted levy)	-0-
Transportation	8.30
Insurance	-0-
Bonded indebtedness/sinking fund	14.15
Gardiner High School District #4	
General (voted levy)	-0-
Transportation	11.07
Insurance	-0-
Bonded indebtedness/sinking fund	-0-
TOTAL	123.51

Sources: Montana Tax Foundation. Mountain International, Inc., 1984, vol. 1, p. 12.

Table II-34: Taxable Value of Gardiner School Districts Selected Fiscal Years

Fiscal Year	Gardiner Elementary District #7		Gardiner High School District #4	
	Nominal dollars	1980 dollars	Nominal dollars	1980 dollars
1983	$1,074,558	$900,496	$1,526,309	$1,279,070
1982	1,126,019	978,434	1,578,848	1,371,912
1981	1,133,532	1,043,199	1,575,574	1,450,014
1980	1,073,614	1,073 614	1,489,881	1,489,881
1975	1,054,931	1,492,748	1,324,881	1,874,733
1972	887,883	1,589,311	1,131,306	2,025,038

Sources: Gardiner School Districts #4 and #7. Mountain International, Inc., 1984, vol. 1, p. 315. Survey of Current Business, July issues, 1977, 1979, 1982, and 1984, implicit price deflator for state and local government expenditures.

Table II-35: Gardiner Service District Budgets FY70, 75, and 80

	1970[1]		1975[1]		1980[1]	
Districts	Nominal dollars	1980 dollars	Nominal dollars	1980 dollars	Nominal dollars	1980 dollars
Fire District						
District taxes	$7,721	$14,941	$9,888	$13,992	$16,020	$16,020
Expenditures						
Operating expenditures	4,620	8,940	7,932	11,224	7,534	7,534
Capital outlays	4,591	8,884	727	1,029	2,686	2,686
TOTAL	$9,211	$17,824	$8,659	$12,253	$10,220	$10,220
Water District						
Revenues						
Commercial	NA		$43,715	$61,858	$47,511	$47,511
District taxes[2]	NA		11,573	16,376	677	677
Miscellaneous	NA		1,098	1,554	-0-	-0-
TOTAL	NA		$56,386	$79,788	$48,188	$48,188
Expenditures						
Pumping and distribution	NA		$ 9,161	$12,963	$ 9,390	$ 9,390
Maintenance and operation	NA		3,333	4,716	4,103	4,103
Miscellaneous	NA		4,872	6,894	10,080	10,080
operating expenditures	NA		17,366	24,573	23,573	23,573
Debt service	NA		10,140	14,348	6,943	6,943
TOTAL	NA		$44,872	$63,494	$54,089	$54,089
Sewer District						
Taxable Value	$42,297	$81,850	$145,106	$205,328	$320,926	$320,926
Taxes levied	212	410	24,560	34,753	24,091	24,091

Sources: Gardiner Volunteer Fire District. Gardiner Water District. Gardiner Sewer District. Mountain International, Inc., 1984, vol. 1, p. 324. Survey of Current Business, July issues, 1975, 1977, 1979, 1982, and 1984, implicit price deflator for state and local government expenditures.

[1] Columns may not sum to totals due to rounding.

[2] District taxes were levied from 1974 to 1976, balances after this date are apparently delinquencies.

NA means not available.

Table II-36 shows the projected total expenditures for Park County from FY1987 to FY2010. Expenditures rise from $2.2 million in FY1987 to $3.5 million in FY2010, for an annual increase of 2.05 percent. Expenditures would be higher if unforeseen capital projects were to be budgeted.

Table II-36: Projected Park County Expenditures FY1987 to FY2010 (1980 dollars)

Fiscal year	Debt service[1]	Capital outlays[1]	Operating expenditures	Total
1987	$26,191	$275,412	$1,866,066	$2,167,669
1988	23,665	277,846	1,912,897	2,214,408
1989	21,842	280,280	1,960,979	2,263,101
1990	19,034	282,737	2,010,353	2,312,124
1995	-0-	301,130	2,279,004	2,580,134
2000	-0-	305,011	2,564,080	2,869,091
2005	-0-	312,543	2,890,441	3,209,984
2010	-0-	319,455	3,142,196	3,461,651

[1] Mountain International, Inc., vol. 1, 1984a, p. 138.

Table II-37 shows the projected increase in expenditures for the elementary school in Gardiner (district #7). Total expenditures are forecast to rise from $425,869 in FY87 to $807,270 in FY2009. Such expenditures indicate that per-student expenditures will also rise from $3,466 to $5,981.

Table II-38 shows projected expenditures for the Gardiner high school district #4. Total costs are expected to rise almost 66 percent from $334,620 in FY87 to $554,091 in FY2009. Per-student costs increase 53 percent over the forecast period.

Table II-37: Forecasted Expenditures for Gardiner Elementary School District #7, FY1987 to FY2009 (1980 dollars)

Fiscal year	Total expenditures	Debt service	Capital outlays	Operating expenditures	Operating expenditures per student
1987	$425,869	$4,583	$15,738	$405,548	$3,466
1988	435,526	4,138	15,738	415,650	3,553
1989	445,469	3,718	15,738	426,013	3,641
1990	455,701	3,320	15,738	436,643	3,732
1995	535,935	-0-	16,545	519,390	4,223
2000	624,155	-0-	17,083	607,071	4,780
2005	721,219	-0-	17,487	707,733	5,413
2009	807,270	-0-	17,755	789,515	5,981

Source: Mountain International, Inc., vol. 1, 1984a, p. 335.

Table II-38: Forecasted Expenditures for Gardiner High School District #4, FY1987 to FY2009 (1980 dollars)

Fiscal year	Total expenditures[1]	Capital outlays	Operating expenditures	Operating expenditures per student
1987	$334,620	$9,870	$324,750	$4,218
1988	340,620	9,870	331,089	4,300
1989	347,425	9,870	337,555	4,384
1990	354,021	9,870	344,151	4,469
1995	409,259	10,393	398,876	4,924
2000	449,976	10,383	439,593	5,427
2009	554,091	10,767	543,324	6,468

Source: Mountain International, Inc., vol. 1, 1984, p. 337.

[1] The district does not have any outstanding debt.

LAND USE

Land uses on the permit area within a five-mile radius of the project and within Park County are similar. Recreation, farming, ranching, residential development, logging, and mining are typical area land uses.

Development of the proposed project would occur on both public and private land. Most of the permit area is privately owned by Homestake Mining Company; however, tailings would be located on a small amount of Forest Service land. Of the 410-acre permit area, 17 acres of land have been previously disturbed by mining activity.

Recreation is a primary land use in the Gardiner-Jardine area. Yellowstone National Park borders Gardiner to the south. The Absaroka-Beartooth Wilderness lies to the east of Gardiner. Nonwilderness Forest Service lands are to the east, west, and north of Gardiner and Jardine. Fishing, hiking, camping, and picnicking all occur on public lands in the project area (see Recreation). Big-game hunting is also a source of recreation--including a regular fall season and a late season in winter.

Residential development is concentrated at Jardine and Gardiner, with some scattered development along the Jardine Road. Ranching is confined to several small properties along Bear Creek near Jardine and Gardiner, and some grazing of domestic livestock, primarily horses, is also present. Mining is limited to panning for gold in Bear Creek and the Yellowstone River, and quarry mining of travertine near Gardiner (project application, 1984, p. 1-H-2).

Logging occurs on public, Forest Service-managed land in the project area. Both commercial harvests and firewood cutting occur. No livestock grazing is allowed on Forest Service lands in the project area (project application, 1984, p. 1-H-1).

Land use within Park County is much the same as the immediate vicinity of the project area. Residential uses are concentrated at existing towns, mainly in Livingston. Small towns north of Livingston (Wilsall and Clyde Park) and south (Emigrant and Corwin Springs) have small amounts of residential development. Otherwise, development is scattered mostly along the Yellowstone and Shields rivers.

Ranching and farming land uses are more prominent in Park County than in the immediate Gardiner area. Although the project area has some livestock grazing (primarily horses), the balance of the county produces alfalfa hay, barley, oats, cattle, hogs, sheep, and small amounts of winter and spring wheat (Montana Agricultural Statistics, County Statistics, 1982 and 1983, vol. XX).

Two private entities own large amounts of land in Park County--the Burlington Northern Railroad (BN) and the Church Universal and Triumphant. The Church Universal and Triumphant began purchasing land in 1981 and is the second largest landowner after BN. The church owns over 30,000 acres, most of it agricultural land (Mountain International, Inc., 1984, vol. 1, p. 105).

Projected Trends

Recreation will remain a dominant land use in the Gardiner-Jardine area. The number of users will fluctuate depending on the level of tourism in Yellowstone National Park, and Montana in general. Fall and winter recreational use will be influenced by hunting regulations determined by the Montana Department of Fish, Wildlife and Parks (see Wildlife).

There will be some conversion of agricultural land to residential development due to population growth. However, the amount of such development will be small.

Farming and ranching will continue in the area. The number of acres in production may decline, if agricultural profitability continues at its present low.

TRANSPORTATION

Park County contains 143 miles of interstate and primary highways, 51 miles of secondary roadways, 846 miles of local roads, and 13 miles of urban streets and roads (Mountain International, Inc., 1984, vol. 1, p. 230). The major roads in Park County are Interstate 90, which runs east and west, and U.S. Highway 89 (also numbered Federal Aid Primary [FAP] 11), which runs north and south (see figure II-30, Chapter II--Recreation).

U.S. 89

U.S. Highway 89 connects Livingston, Gardiner, and Yellowstone National Park. The condition of U.S. 89 was surveyed by the Montana Department of Highways (MDOH) in 1983 and received 74.2 out of a possible 100-point score for factors such as safety, drainage, and surface sufficiency. All but one section of U.S. 89 received a maximum score of 10 for drainage sufficiency. Safety ratings were high in 6 of 10 sections. Safety-deficient sections are at the Yellowstone National Park boundary (mile post 0), north of Corwin Springs (mile posts 10.8 to 16.6), near the southern junction of U.S. 89 and Federal Aid Secondary (FAS) 540 (mile posts 19.3 to 30.9), and north of Emigrant (mile post 40.7 to 51.8) (MDOH, 1983, p. 35). Capacity ratings were generally 20 or better out of a possible-30 score, with the lowest capacity rating of 18 at the park boundary. Surface stability ratings were 21 points or greater (out of a possible 30) for all sections of U.S. 89 except the section north of Emigrant (mile posts 40.7 to 49.9), which received a 17. A nine-mile section of U.S. 89 directly south of the northern junction with FAS 540 was rated as deficient (MDOH Sufficiency Ratings, 1983, pp. 107 and 109).

Table II-39 lists the average daily traffic (ADT) measured at three locations on U.S. 89 near Gardiner between 1970 and 1983. The highest and most consistent rates of growth in ADT occurred at the border of Yellowstone National Park. Between 1970 to 1984, ADT at that location increased at an annual rate of 7 percent. The 10-year rate of change was 9 percent and ADT increased at an annual rate of 15 percent over the most recent five years.

Traffic counts on U.S. 89 taken at the northern edge of Gardiner showed smaller increases over the same time period. Traffic counts grew at average annual rates of 3 percent between 1970 and 1984; 4 percent between 1975 and 1985; and 7 percent between 1980 and 1985 (see table II-39).

A permanent traffic counter 20 miles north of Gardiner near the southern junction of U.S. 89 and FAS 540 records counts 24 hours each day, year round. Recorded ADT at this location increased 2.4 percent between 1970 and 1983, and 1.7 percent between 1979 and 1983. Over the last five years, ADT has decreased from a peak of 1,186 vehicles per day in 1979 to 960 vehicles per day in 1983, for an average annual decline of 4.3 percent. However, ADT at the southern U.S. 89-FAS 540 junction increased from 880 in 1982 to 960 vehicles per day in 1983, possibly signaling renewed long-term traffic increases.

Accident rates and traffic accident fatality rates for U.S. 89 between Gardiner and Livingston are below those for the state as a whole (see table II-40). The statewide accident rate per million vehicle miles driven is 2.67 for secondary roads (Willard Butzlaff, Supervisor, Project Planning Section, MDOH, pers. comm., May 29, 1985). The section of U.S. 89 between Livingston and Gardiner has an accident rate of 2.5 accidents per million vehicle miles driven, slightly lower than the statewide rate.

From 1972 to 1982, there was an average of 42 accidents yearly on U.S. 89 south of Livingston. During the same time period, nine traffic-related fatalities occurred on that stretch of road.

Jardine Road

A two-lane gravel surface road 4.6 miles long, called the Jardine Road, connects Gardiner and Jardine. The Jardine Road provides access to scattered

Table II-39: Average Daily Traffic for Selected Locations on U.S. 89

Year	Yellowstone National Park boundary[1]	Gardiner outskirts[2]	Junction U.S. 89 and FAS 540[3]
1983	3,025	1,155	960
1982	2,400	1,114	880
1981	2,510	1,125	950
1980	1,730	847	920
1979	1,493	819	1,186
1978	1,717	1,007	893
1977	1,639	907	885
1976	1,267	846	813
1975	1,317	919	854
1974	990	727	764
1973	1,086	730	798
1970	1,150	679	691
1970-1984 Annual rate of change	7.015%	3.087%	2.38%
1973-1984 Annual rate of change	9.076%	4.026%	1.69%
1979-1984 Annual rate of change	15.170%	7.120%	(-4.31%)

Source: MDOH, Traffic By Sections, 1970, 1973, 1975, 1976, 1979, 1981, and 1983.

[1] The traffic counter is located at mile post 0.00 at the border of Yellowstone National Park.

[2] The traffic counter is located at mile post 0.787 near the outskirts of Gardiner.

[3] The traffic counter is located at mile post 19.731 near the southern junction of U.S. 89 and FAS 540. This counter is a permanent station which records traffic flows 24 hours per day, year round.

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residences, is used by summer recreationists and by hunters in the fall, and also provides access to the project site. The first mile of the road has steep grades and switchbacks up Z-Hill above Gardiner. The road then traverses high, open benchland before traveling through Bear Gulch, where the road has a steep southside embankment (Mountain International, 1984, vol. 1, p. 238).

A study was undertaken in 1982 to identify high-hazard road locations in Park County. Of the six locations identified, two were on the Jardine Road (Peccia and Associates, Inc., Park County High Hazard Site Locations, 1983, p. 1).

Table II-40: Comparison of Accident Rates for U.S. 89 Between Livingston and Gardiner and Statewide Averages

	All accidents		Rate for 100,000 population		Fatal accidents		Rate for 100,000 population	
Year	U.S. 89	Statewide	U.S. 89	Statewide	U.S. 89	Statewide	U.S. 89	Statewide
1982	46	19,382	359.4	2,409.2	2	215	15.6	26.7
1981	59	21,310	460.9	2,694.1	1	289	7.8	36.5
1980	57	21,359	450.2	2,715.1	2	276	15.8	35.1
1979	47	22,474	350.8	2,859.3	1	275	7.5	35.0
1978	58	24,138	446.2	3,074.9	0	234	0.0	29.8
1977	61	21,705	488.0	3,852.2	0	261	0.0	34.3
1976	39	19,737	309.5	2,621.1	1	249	7.9	33.1
1975	31	18,738	258.3	2,505.1	0	248	0.0	33.2
1974	33	15,760	277.3	2,144.2	0	247	0.0	33.6
1973	29	15,788	245.8	2,189.7	1	273	8.5	37.9
1972	42	16,262	355.9	2,261.8	1	313	8.5	43.5

Source: Mountain International, 1984, vol. 1, pp. 236-237.

The first site is 0.3 miles northeast of U.S. 89 in Gardiner and consists of a hairpin curve through a new residential section. In addition to steep grades through the curve, visibility is limited to 100 feet in several locations (Peccia and Associates, Inc., 1983, p. 31).

The second high-hazard site on the Jardine Road is a 4.3-mile section extending from the switchbacks at Gardiner to the edge of Jardine. Sight distance is restricted to less than 100 feet in several locations due to road grades and curves. Extremely steep side slopes are another hazard of the upper Jardine road (Peccia and Associates, Inc., 1983, p. 34).

On October 25, 1982, a 24-hour traffic count was made on the Jardine Road. A total of 256 vehicles was recorded during that time. An ADT of 233 was calculated by applying factors used by MDOH which reflect statewide traffic patterns that vary according to season and day of the week (Robert Peccia, pers. comm., May 23, 1985). The estimated ADT of 233 for the Jardine Road may be too high; its reliability cannot be verified. The counter was placed on the upper Jardine Road and the count was taken one day after the opening of the deer and elk hunting season, so it would reflect high recreational use which may not be typical of general traffic conditions on the road. The method used to calculate the ADT for the Jardine Road was developed by MDOH for roads in the state which are more typical of traffic patterns on roads similar to U.S. 89 than those on roads which receive sporadic, heavy recreation use. For example, a permanent counter near Hungry Horse Dam recorded a fluctuation in average daily traffic from 817 vehicles in July 1984 to a low of 23 ADT in December, or a range of 3,552 percent. The annual ADT at Hungry Horse was 272 in 1984 (MDOH, Automatic Counters, 1984, Station A-45). By comparison, the fluctuation in average daily traffic measured at the permanent counter on U.S. 89 varied from a peak ADT of 2,098 in July, 1984 to a low of 500 ADT in December, or a range of 420 percent (MDOH, Automatic Counters, 1984, Station A-20). The annual ADT was calculated at 1,012 for 1984.

In December of 1985 Park County placed a traffic counter on the lower end of Jardine Road. Data was collected Thursday through Monday of the late-season elk hunt. Two weekend counts show wide fluctuations in traffic patterns, with totals increasing over 1,000 percent from Thursday throughout the weekend and dropping back again on Monday.

Between 1979 and 1982, four accidents were reported on the lower Jardine Road and five were reported on the upper section (Peccia and Associates, Inc., 1983, pp. 31 and 34). All of the accidents on the lower section resulted in injuries. There was one fatality and one injury in the accidents that occurred on the upper section. Four of the five accidents involved vehicles rolling down the steep embankment.

Future Traffic Conditions on U.S. 89

Table II-41 presents forecasted traffic increases for U.S. 89 between Gardiner and Livingston without the Jardine Joint Venture project. These forecasts are based on accident, traffic, and fatality rates between 1972 and 1982. Data for changes on the Jardine Road were not available.

Average daily traffic on U.S. 89 is expected to increase from 1,006 vehicles per day in 1985 to 1,811 ADT in 2010. Over that period, a total of 30 fatalities may occur as a result of accidents. Between 1,746 to 1,898 traffic accidents are expected to occur over the forecast period.

RECREATION

Natural Resources

The primary recreational resources of the project area include Yellowstone National Park, the Gallatin National Forest, and the Yellowstone River and its tributaries. Recreational opportunities exist at both developed and undeveloped sites throughout the county. Figure II-30 identifies the boundaries of the Gallatin National Forest in Park County, Yellowstone National Park (YNP), the Yellowstone River, and a series of campgrounds and public fishing access sites developed to enhance use of the resource base. Several trails wind throughout the study area (figure II-29).

Park County contains several public campgrounds operated by the U.S. Forest Service. Three campgrounds are near Cooke City. Other campgrounds are near the Gallatin County border in Tom Miner Basin, Emigrant Gulch, near the Pine Creek Bridge along the Yellowstone River in the northern portion of the Paradise Valley, and along the county's eastern border; all are accessible through Sweet Grass County.

Table II-41: Projected Traffic and Accident Rates for U.S. 89 Between Livingston and Gardiner

Year	Average daily traffic[1]	Total annual mileage (millions)	Low accident rate[2]	High accident rate[3]	Fatalities[2]
1985	1,006	19.02	47	51	1
1990	1,132	21.40	53	57	1
1995	1,273	24.07	59	64	1
2000	1,432	27.07	67	72	1
2005	1,611	30.46	75	81	1
2010	1,811	34.26	84	91	1
TOTAL[4]	N/A	710.68	1,746	1,898	30

[1] Traffic is assumed to increase on U.S. 89 between Gardiner and Livingston at the historic (15-year) rate as measured at the permanent traffic counter located near the southern junction of U.S. 89 and FAS 540. Traffic count estimates are based on the 1983 reading of 960 vehicles per day at the permanent traffic counter.

[2] Accident and fatality estimates for U.S. 89 were developed by the Department of State Lands. The accident rate was calculated to be 2.457 accidents per million vehicles miles driven. The fatality rate was calculated to be 4.27 fatalities per one hundred million vehicle miles driven. Total annual miles driven was calculated by multiplying average daily traffic counts times the segment length (51.8 miles) times 365 days per year. Each year from 1972 to 1982 was summed and the total was divided by one million to arrive at an adjusted total mileage. The total number of accidents which occurred from 1972 to 1982 was then divided by the adjusted total mileage to determine the number of accidents per million vehicle miles driven. The number of fatalities was expressed as a number of fatalities per one hundred million vehicle miles driven. The total number of fatalities was divided by the total adjusted mileage and then multiplied by 100.

[3] The statewide accident rate per million vehicle miles driven is 2.67 for secondary roads over the period 1977-1984 (Willard Butzloff, Supervisor, Project Planning Section, MDOH, per. comm., May 29, 1985).

[4] Totals will be greater than the sum of each forecast point, because totals reflect each annual change which is not listed in the table.
N/A means not applicable.

The Montana Department of Fish, Wildlife and Parks maintains 16 fishing access sites in the county, starting with the Queen-of-the-Waters and Corwin Springs sites near Gardiner. The remaining 14 sites are stretched out along the Yellowstone River to Springdale on the county's eastern border (figure II-30). The National Park Service and TWA Services, Inc., provide campgrounds, lodging and meal services, interpretive trails, and other visitor services throughout the park.

Major recreation activities throughout the project area include hunting, fishing, hiking, horseback riding, wilderness camping, some snowmobiling, and antler collecting (see table II-42). This last activity is illegal in Yellowstone National Park.

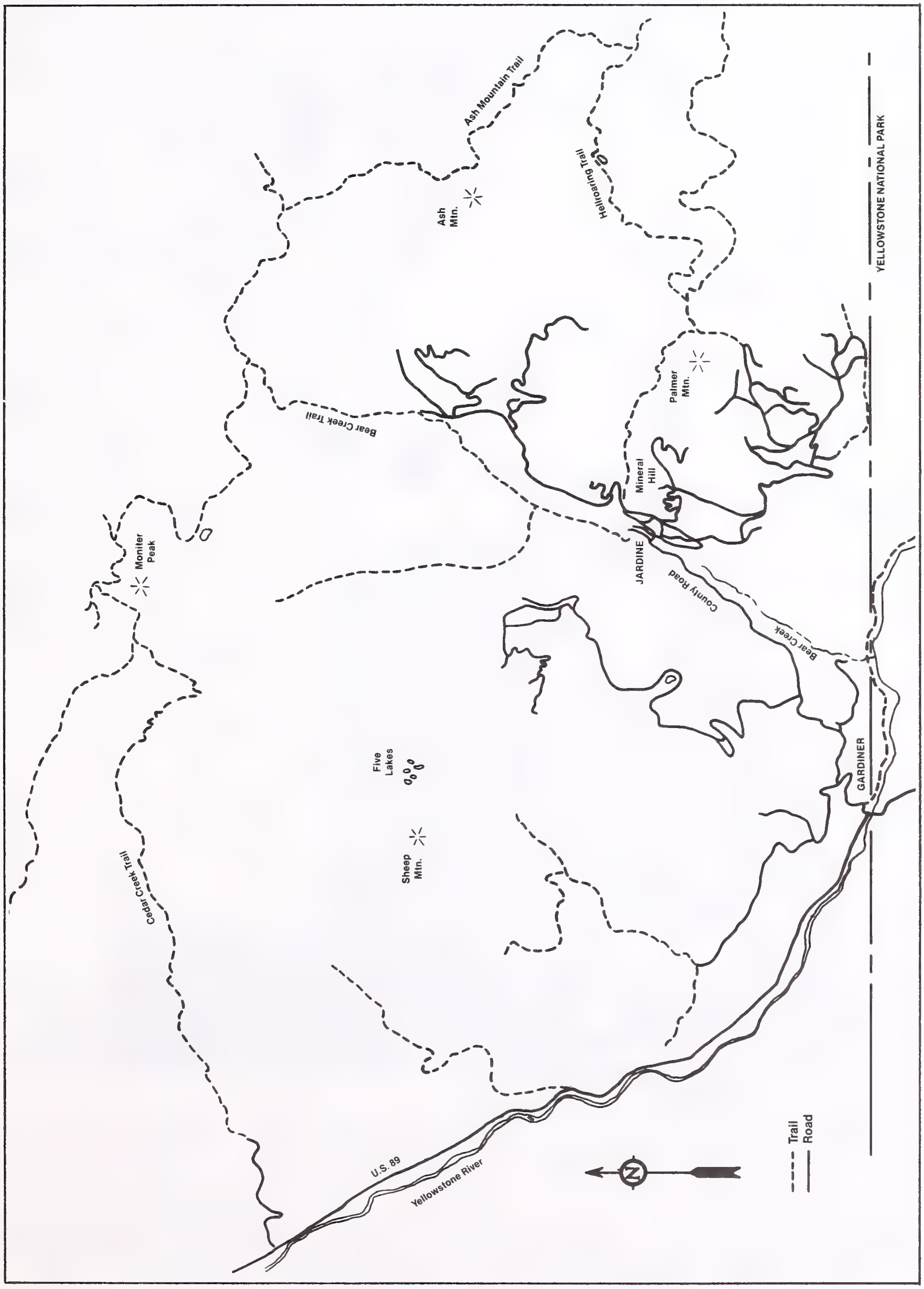

Figure II-29: Several Forest Service-maintained trails and roads wind throughout the study area.

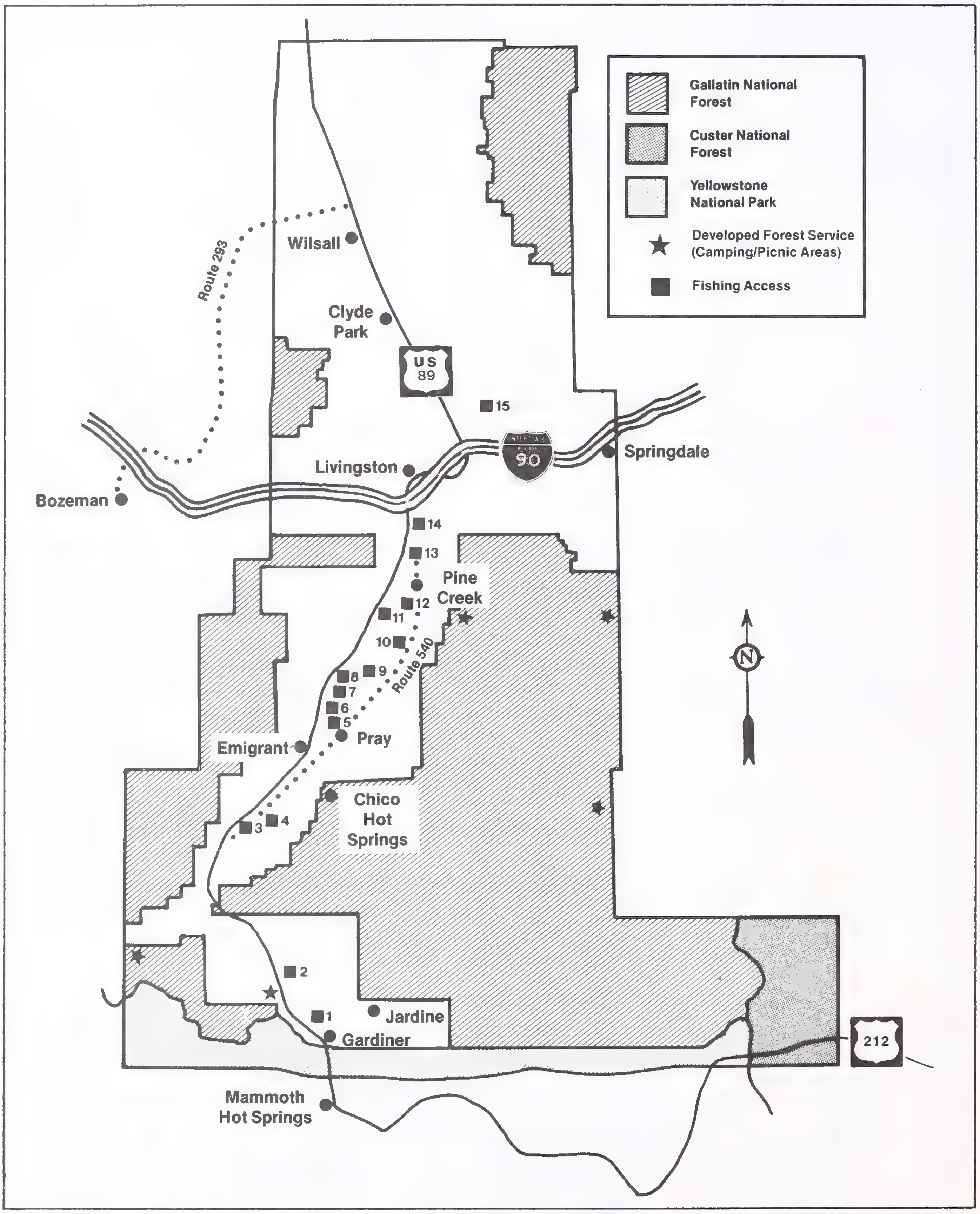

Figure II-30: Fifteen fishing access sites are maintained by the Montana Department of Fish, Wildlife and Parks. The U.S. Forest Service maintains developed camping and picnic areas in the Gallatin National Forest. These fishing access sites primarily line U.S. 89.

Table II-42: Human Activity in the Jardine Wildlife Study Area, 1981-1982

Category	Number of observations	Percent of observations	Remarks
Cross-county skiing	4	1.3	
U.S. Forest Service employees	5	1.4	Includes weed spraying, tree planting, trail maintenance, other FS activities
Horse packing	7	1.9	Does not include hunters
Hiking/fishing	9	2.5	Does not include hunters
Firewood/logging	11	3.2	
Recreation driving/ sightseeing	14	3.8	
Camping	38	10.8	Does not include hunters
Antler collecting	63	17.8	
Hunting	205	57.3	Bow hunting, gun hunting, camping, horse packing and associated activities
	356	100.0	

Source: Westech, 1984.

Visitation

Table II-43 summarizes visitor counts conducted at 8 of the county's 15 fishing access sites. The greatest volume of use takes place at Daily Lake in the Paradise Valley and at Carter's Bridge on the outskirts of Livingston. In general, visitors are more frequent at sites in the northern Paradise Valley near Livingston than at locations near Gardiner.

Little information exists about fishing pressure on Bear Creek. The Montana Department of Fish, Wildlife and Parks estimates that 919 man days of fishing pressure occurred during the period April 1, 1982 through March 31, 1983 (Bob McFarland, pers. comm., March 13, 1985).

Table II-43: Visitor Use of Park County Fishing Access Sites, 1980-1983 (see figure II-30 for location)

No.	Site	1980	1981	1982	1983
1	Queen-of-the-Waters	800	900	900	1,000
2	Corwin Springs	no count	no count	no count	2,400
3	Point of Rocks	no count	no count	no count	no count
4	Daily Lake	19,300	18,800	23,000	no count
5	Emigrant	3,300	3,700	3,800	no count
6	Emigrant North	no count	no count	no count	1,000
7	Grey Owl	no count	no count	no count	no count
8	Chicory	no count	no count	no count	800
9	Paradise	no count	no count	no count	4,000
10	Loch Laven	4,100	4,100	3,900	no count
11	Mallard's Rest	6,500	14,000	14,900	16,200
12	Pine Creek Bridge	no count	no count	no count	10,200
13	Carter's Bridge	4,100	21,600	23,000	no count
14	Free River	no count	no count	no count	3,800
15	Sheep Mountain	3,300	3,100	4,100	3,300
16	Springdale Bridge	3,300	4,500	4,400	4,500

Source: Montana Department of Fish, Wildlife and Parks (1983).

Organized Recreation

Outside the immediate Livingston area there is relatively little organized recreation. Gardiner has an informal softball league that participates in the Yellowstone Park Recreation Program softball series. There is no Little League or similar organization for Gardiner's youth.

Interscholastic high school sports provide a recreational outlet for the area's youth during the school year. The area's adults are reportedly very active supporters of the school's athletic program and have organized a Gardiner High School booster club.

There are several formally organized recreational programs in the area. One is the Yellowstone Park Recreation Program, located in Mammoth, Wyoming. This program, funded by the National Park Service and park concessionaires, is for park employees. It organizes discount-rate, white-water raft trips, movies, dances, various team sports, and classes in dance, arts and crafts, exercise, sports, and the like. Although the program is organized for park employees, some Gardiner area residents who do not work in Yellowstone participate in basketball, volleyball, and softball programs. Gardiner school playing fields are available for some events.

The Interpretive Division of the Park Service holds summer and winter activities near Mammoth. Such activities include nature walks on the hot springs and terraces, evening programs at the Mammoth Campground and the Mammoth Hotel, and activities associated with the Horace Albright Museum.

Finally, a small alpine ski hill is available in the Mammoth area; Gardiner school children use this resource one day a week. Scouting units for boys and girls also have been organized in the area.

One theater, which operates in the summer, and a number of taverns (see Commercial Services) also serve as recreational outlets in Gardiner. The Chico Hot Springs Lodge, providing food, drink, lodging, swimming, hot tubs, and a hot pool, is about 33 miles north of Gardiner, off U.S. Highway 89.

National Forest

The closest developed national forest campground is in Tom Miner Basin--about 30 miles by road from the project site. This campground is seldom used to its 12-family-unit capacity. There is a roadside picnic ground--a rest stop at LaDuke Springs about 10 road miles northwest of the project area. There are also several minimum-development occupancy sites within 10 to 20 miles of the project area including Eagle Creek and Yankee Jim Brown. These sites have minimum facilities--usually just a few parking spaces, a toilet, and a few fire rings.

A portion of the Yellowstone River flows through scattered national forest tracts between Yellowstone Park and Yankee Jim Canyon. This stretch of the river experiences moderate fishing pressure. Outfitters provide floating and fishing service in addition to moderate public floating use.

There are four access points to the Absaroka-Beartooth Wilderness in the project area: Palmer, Pine Creek, Knox Lake, and the North Fork Bear Creek trailheads. In addition, several outfitters permitted on the Gardiner district operate all summer and fall on trails into the Absaroka-Beartooth Wilderness from the Jardine area.

There is a large occupancy site up Bear Creek beyond Jardine, which is used occasionally by large, organized groups for camping. A small, undeveloped occupancy site near Knox Lake trailhead is used summer and fall for camping.

The Draft Gallatin Forest Plan projects recreation trends in the next decade as noted below.

--Developed recreation (camp, picnic grounds) up 15 percent,
--dispersed recreation (non-wilderness) up 22 percent, and
--wilderness recreation up 14 percent.

This estimate is appropriate for the national forest surrounding the project area.

CULTURAL RESOURCES

An intensive cultural resource inventory covering about 3,100 acres of private and USDA Forest Service lands in Park County was conducted during

1981-1982 (project application, 1984). One of the primary objectives of the survey was to locate sites included on or potentially eligible for inclusion on the National Register of Historic Places (NRHP).

Six cultural resources sites--two archaeological and four historic--were identified during the surveys. One archaeological and two historic sites are considered eligible for listing on NRHP.

Both archaeological sites are located on terraces near the confluence of Bear and Palmer Creeks. Site 24 PA340 is small (14,000 square feet) with little cultural material. Fewer than 50 fragments, predominantly obsidian, were found. Subsurface testing encountered no intact cultural levels. The site appears to have been a short-term lithic workshop and possible hunting observation area. The site is ineligible for the NRHP.

The second archaeological site (24PA159) is larger (58,000 square feet) and located just south of Palmer Creek. Several hundred pieces of obsidian, chert, and agate were found, including an apparent Late Middle Prehistoric Period or Pelican Lake corner-notched projectile point, an obsidian biface fragment, and a quartzite spall chopper-scraper. In addition, plowing reportedly exposed rock-filled hearths. Four test pits yielded cultural material, including charcoal to a depth of two feet. The site appears to be a campground which may have been reused. The site warrants a recommendation of eligibility on the NRHP.

Of the four historic sites, two are considered eligible for the NRHP. The major site (24PA339) is the Jardine, Montana, Noncontiguous Historic District (figure II-31). Historic Research Associates (HRA) recommended that 49 of the 165 historic structures and features (table II-44) be included in the historic district (project application, 1984). These structures include most of the extant buildings constructed during the late 1890s and early 1900s, the first period of significant mining activity in Bear Gulch. These structures include the Revenue Mill (Structure 34) and several associated structures (Structures 36, 37, 41, 43, 53, 54), the mine office (Structure 73), the guest house (Structure 67), and the schoolhouse (Structure 79). Also represented are a number of structures built shortly after the Jardine Mining Company reopened the mining and milling operations in the early 1920s. These structures include the arsenic mill (Structure 59) and a number of residential dwellings. It was during the period from 1920 to 1948 that Jardine gained prominence as a nationwide leader in the production of commercial arsenic and tungsten.

In addition to the structures and features described above, there are two structures and one feature located outside the immediate vicinity of Jardine that should be included as noncontiguous portions of the historic district. These include the Stuart-Schultz Cabins (24PA410, Feature 164), the George Welcome-Harry C. Bacorn residence (Structure 103), and the Jardine water supply system. Dr. James Stuart, the assayer for the Bear Gulch Mining Company, was an important individual in the early development of Jardine. George Welcome, who arrived in Jardine in the 1890s, was associated with Harry Bush in the Bear Gulch Mercantile and Land Company. He also operated a hotel and general merchandise store in Jardine. His house (Structure 103) was built in the early 1900s and was later occupied by Harry C. Bacorn. Bacorn was the manager of the Jardine Mining Company in the early 1920s and was instrumental in the mining revival that characterized Jardine in that decade. The Jardine water supply system, which consists of a dam, pond, and wooden flume (Feature 163), was constructed in 1903; it was designed to supply water for the mills and residences in Jardine. The above structures and features are essential parts of the Jardine Historic District and should be included as noncontiguous portions.

The buildings included in the proposed historic district thus represent two significant periods in the history of mining and milling development in the West (1890-1900, 1920-1948). The industrial and residential buildings included in the proposed Jardine Historic District potentially contain information about changes in mining and milling technology and changes in construction techniques that occurred between 1900 and the 1920s. Also, the arsenic mill represents a technological as well as an economical innovation in national mining history that occurred in the late 1910s when arsenic, once considered a by-product of the milling operation, became an economically attractive product. Finally, the structures within the proposed historic district are closely associated with prominent individuals instrumental to local and regional economic development.

HRA recommends that 116 structures and features located in or near Jardine be excluded from consideration as part of the proposed historic district for several reasons. Many of the structures (Structures 80-101) are located in an area that was formerly the commercial center of Jardine. The majority of commercial buildings, constructed during the later 1890s and early 1900s, were dismantled, removed or burned after the United States government sold the town in 1964. This concentration of buildings has therefore lost the most important element that would have qualified it for consideration as part of the historic district. Structures 84-86 are modern mobile homes--nonconforming structures that detract from the integrity of the other buildings. Many older structures are the badly deteriorated remains of shed or barns. It has not been possible to determine the dates of construction or ownership.

Structures 1-33, located on the west side of Bear Creek, include a number of badly deteriorated vertical plank sheds and log structures, several log dwellings in relatively good condition, a modern log home (Structure 8), a mobile home, and a cinder block building. Before the 1960s, land along the west bank of Bear Creek contained numerous log dwellings constructed in the early 1900s by the Bear Gulch Mining Company for its employees. Most of these structures were torn down, moved, or burned in the 1960s. Several structures in this area are probably remnants of these buildings, but they are generally in poor condition or have partially collapsed. A number of structures in this area, built after 1940, do not represent the development of the community between the late 1890s and the 1930s. Also, several of the structures (including the mobile home and cinder block building) are nonconforming structures that are an intrusive element.

Structures and features 104-162 consist of two mill tailings ponds, a number of collapsed mine adits and prospect holes, waste dumps, wooden ore chutes, and portions of a deteriorated trestle. Most of the structures and features are located in Mineral Hill, east of Jardine. Although associated with mining activity in Jardine, the mine adits and related structures are in extremely poor condition. They are generally inaccessible, thus do not contribute to a better understanding of the mining operation.

Table II-44: Jardine Historic District Structures and Features

Number	Type of Structure	Condition	Significant	Contributes	Neutral	Intrusive
S.34	Revenue stamp mill	Poor	X			
S.35	Wood and concrete foundation	Very poor		X		
S.36	Frame water storage building	Poor	X			
S.37	Frame building (ore station)	Poor	X			
S.38	Ore car	Good		X		
S.39	Frame and concrete powerhouse	Good		X		
S.40	Frame tram control house	Fair		X		
S.41	Frame compressor house	Poor	X			
S.42	Squared timbers-mine portal	Very poor		X		
S.43	Frame blacksmith shop	Poor	X			
S.44	Squared timbers-mine portal	Very poor		X		
S.45	Frame outhouse	Very poor		X		
S.46	Frame shack	Poor		X		
S.47	Frame shack	Poor		X		
S.48	Wooden trestle	Very poor		X		
S.49	Frame and metal office	Very poor		X		
S.50	Frame "dry house"	Very poor		X		
S.51	Wooden fly wheels	Poor		X		
S.52	Wooden sluice box	Poor		X		
S.53	Several frame structures	Poor		X		
S.54	Frame electric substation	Poor	X			
S.55	Stone and metal "oven"	Very poor		X		
S.56	Frame shed	Fair		X		
S.57	Metal machinery/parts	Very poor		X		
S.58	Frame assay office	Poor		X		
S.59	Frame and bean "arsenic plant"	Poor	X			
S.60	Concrete and metal "refining furnace"	Very poor		X		
S.61	Wooden "cyanide vats"	Very poor		X		
S.62	Frame and metal garage	Fair		X		
S.63	Log house	Fair		X		
S.64	Log house	Poor		X		
S.65	Log house, wooden shake ext.	Poor		X		
S.67	Frame "guest house"	Good	X			
S.68	Mobile home	Good				X
S.69	Stone fireplace	Good			X	
S.70	Log "bunkhouse"	Fair		X		
S.71	Two log cabins	Good		X		
S.72	Wooden bridge	Good			X	
S.73	Frame "mine office"	Good	X			
S.74	Frame house	Excellent			X	
S.75	Frame house	Excellent			X	
S.76	Frame house	Excellent			X	
S.77	Frame house	Excellent			X	
S.78	Frame house	Excellent				X
S.79	Frame schoolhouse	Good	X			
S.103	Frame house	Good	X			
S.163	Frame house (24PA410)	Good	X			
F.164	Water supply system	Poor	X			

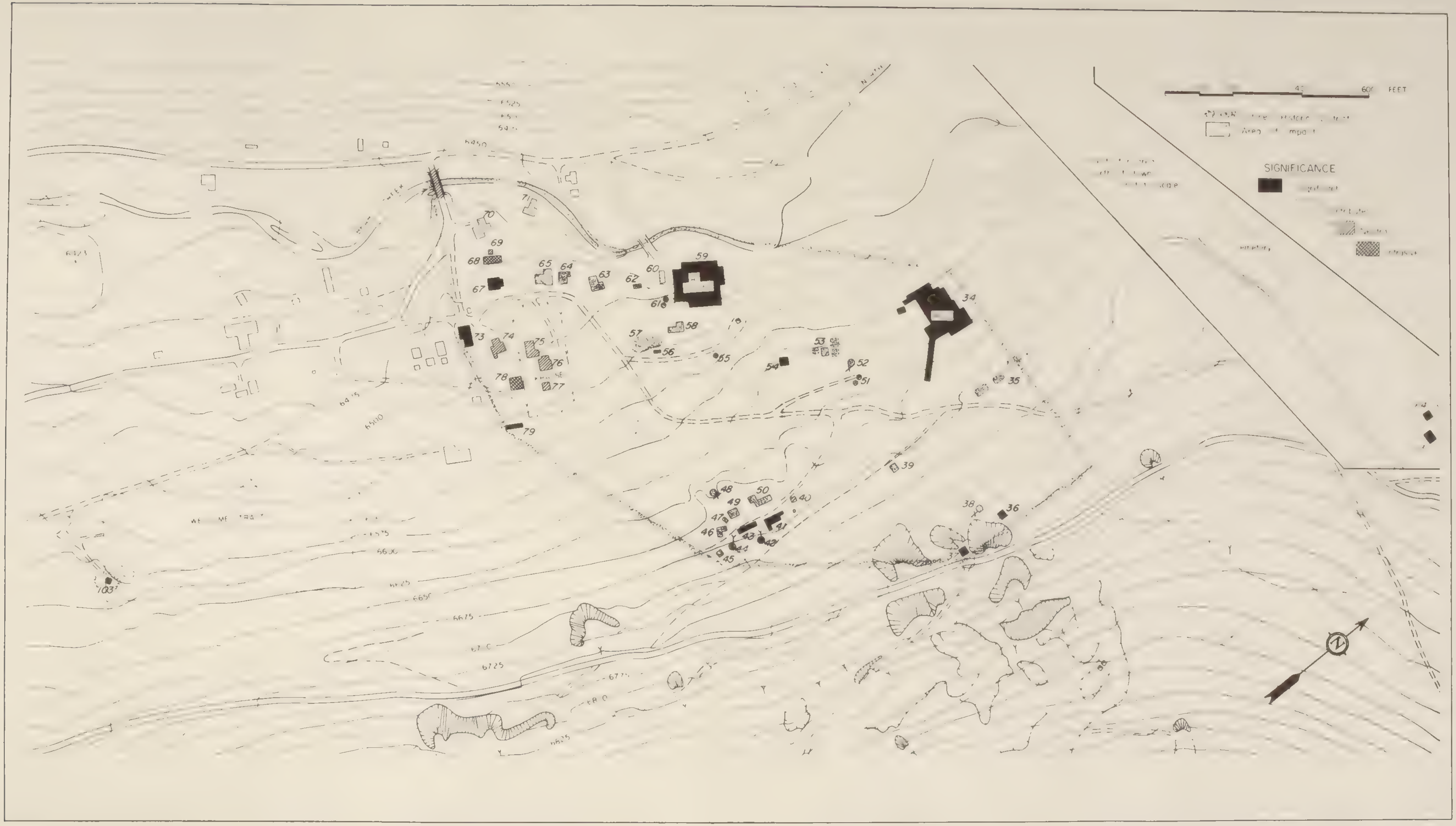

Figure II-31: Historical Research Associates recommended that 49 of the 165 historic structures and features in Jardine be included in the historic district.

There are no individuals buried in the Jardine cemetery (Feature 165) that are of "transcendent importance"; the cemetery is not extremely old (the oldest headstone dates to 1899) and contains no distinctive design features.

The Jardine Historic District (24PA339) is described as follows:

> Beginning at the southeast corner of Structure 79 (figure II-31) and proceeding directly northeast to the southeast corner of Structure 45. From the southeast corner of Structure 45 proceeding northeast to the southeast corner of Structure 37, then north to a point directly east of the northeast corner of the northernmost foundation that comprises Structure 35. From this point, the boundary proceeds west to a point directly north of the northwest corner of Structure 34, then proceeds southwest to a point located on the east bank of Bear Creek, directly west of the northwest corner of Structure 59. The boundary then follows Bear Creek to the west side of Structure 72. From the west side of Structure 72, the boundary runs southeast to the southwest corner of Structure 73, then follows the south wall of Structure 73 and proceeds to the point of beginning at the southeast corner of Structure 79.

The noncontiguous portions of the Jardine Historic District include only the immediate area around Structures 103 and 163 (24PA410) and Feature 164.

Site 24PA185 (Mineral Hill Cabins) and Site 24PA342 (Hanlon Hill adits) are recommended as not eligible for listing on the NRHP. Only portions of the Mineral Hill Cabins' walls remain intact and are not an integral part of the Jardine townsite. The adits and shafts at Hanlon Hills are collapsed and no structures are located on the site.

AESTHETICS

The region surrounding the proposed permit area is primarily mountainous, characterized by steep slopes and deep entrenchment of active streams. The area is typified to the west by rolling upland benches that fall steeply to the drainage bottoms.

The proposed permit area includes part of the steep, forested mountain (Mineral Hill) above the town of Jardine. The proposed tailings area is a relatively level bench about 250 feet above Bear Creek.

The aspect of the permit area is generally north and west. Douglas-fir vegetation types dominate on the lower forested elevations. The tailings area is vegetated with an open-sagebrush type mixed with Douglas-fir.

Evidence of man's activities are present throughout the proposed permit area. Abandoned buildings, waste dumps, tailings ponds, exploration trails, and clear cuts and logging areas are common. A few individuals live in the town of Jardine year round. Present human activities include firewood cutting, gardening, livestock use, vehicle traffic, hunting, and fishing.

The permit area is visible in the distance from the northern region of Yellowstone, especially the area around Mammoth, including the scenic walk through Mammoth Terraces. The visibility of the permit area from the Absaroka-Beartooth Wilderness is limited.

Sound levels in the Jardine area have not been measured. The population is small and no major noise sources are present; therefore, the average noise level is probably similar to other small towns--about 45 decibels dB(a) [Elred, 1974]. Intermittent loud sounds from mine exploration, traffic, light aircraft, farm equipment, chain saws, and firearm discharge are probably the major sources of noise. Some local residents have been disturbed by the noise from a compressor at the exploration activities (project scoping meeting November 14, 1984). Natural sound sources would include Bear Creek, wind, rain, thunder, and wildlife.

Chapter III: Impacts of the Proposed Project

GEOLOGY

Summary: The tailings dump would be very stable during the operation of the mine and for centuries to follow. Excessive erosion and gullying could occur in the diversion ditch alongside the tailings dump during a 100-year flood event.

Geomorphic Stability

The terrace on which the Jardine Joint Venture proposes to place tailings (see figure III-1) would be stable during operation of the mine and for centuries to follow. Occasional slump failures along the steep slopes adjacent to Bear Creek would occur as a consequence of natural erosional processes, but would not endanger the tailings dump; three relatively recent natural slumps have fallen into Bear Creek (see Chapter II--Geology, Surface Deposits of Bear Creek).

The diversion ditch along the southeastern edge of the tailings dump (see figure III-2) would be subject to erosion during heavy runoff events. The applicant proposes to line the upper section of the diversion channel with grass. This segment would have an average slope of 5 to 10 percent. Flow velocities much greater than a 100-year event could initiate gully erosion (Haan and Barfield, 1979, p. 136). On the steeper section (22 percent slope) near the downstream end of the dump, the applicant would line the channel with mine waste rock (riprap) averaging 18 inches in size. The riprap, however, would not be stable under the 100-year flood event (U.S. Environmental Protection Agency, 1976, p. 46); flow velocities during such an event would wash away the riprap and lead to gully erosion.

The applicant's reclamation plan would control sheet and rill erosion off the tailings dump slopes. Soil loss due to erosional processes would be low--probably less than five tons/acre/year. Vegetation covering the dump would prevent excessive erosion. Protective layers of pebbles would develop over time from the coarse-textured soils, and would cover the reclaimed slopes and also help reduce erosion (Megahan, 1974).

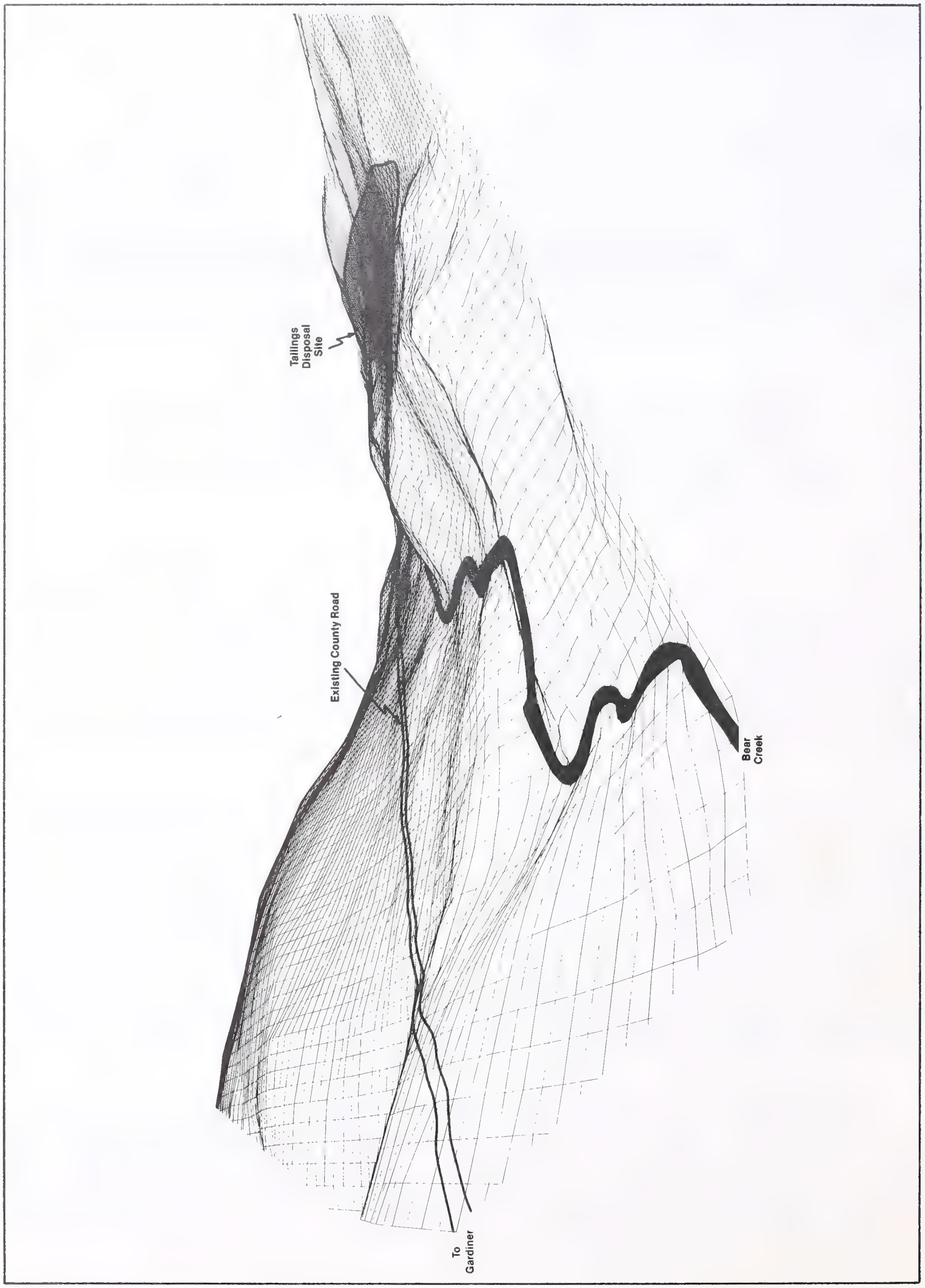

Figure III-1: The proposed tailings dump site is superimposed on this computergraphic of the project area.

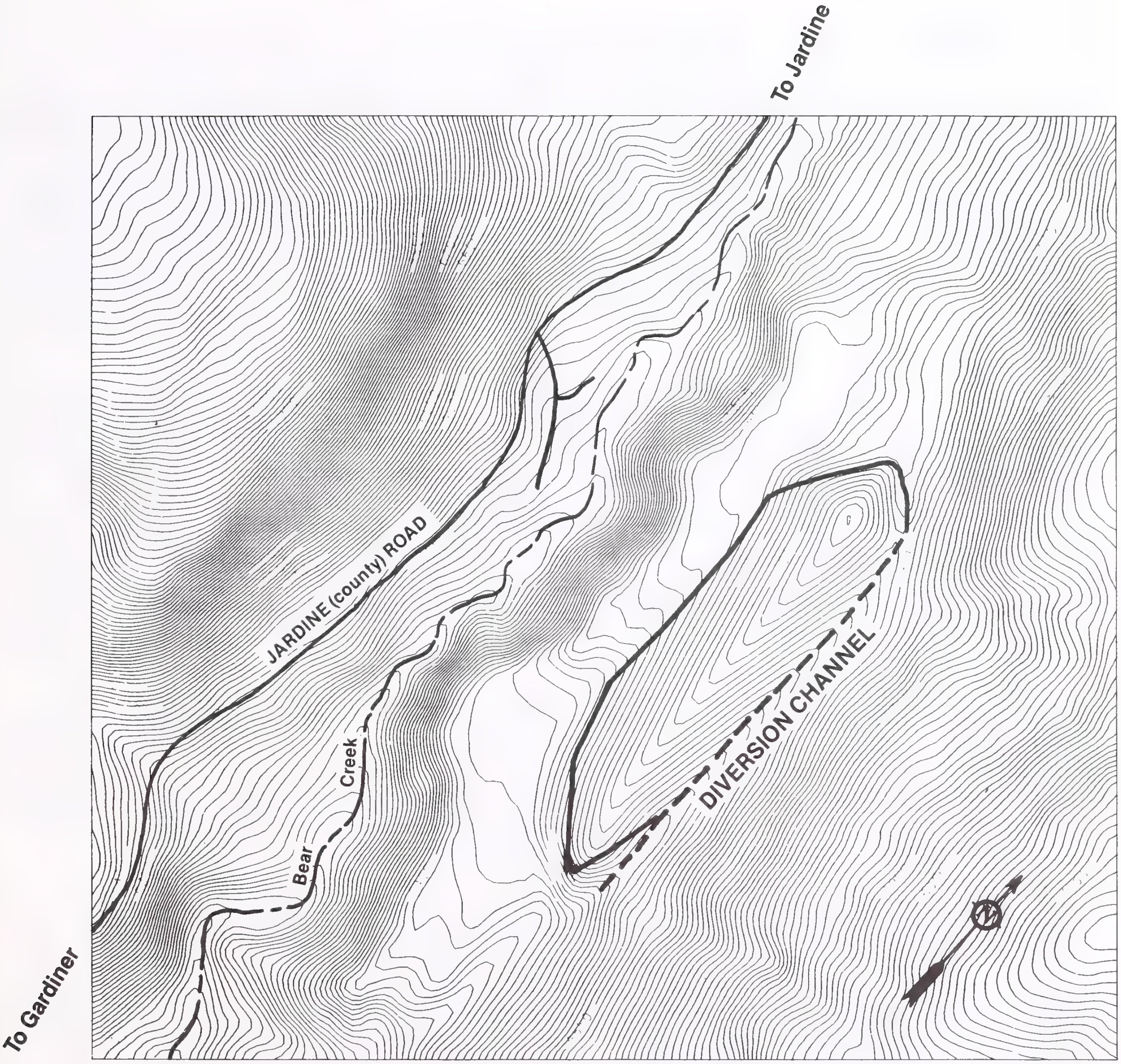

Figure III-2: The proposed tailings dump would ultimately alter the existing topography to the extent shown here.

Gullies may develop on the reclaimed dump surface in places where runoff waters concentrate. Because the dump would be reclaimed in stages, the applicant would be able to treat gully erosion immediately during the initial stages of development. Adjustments to undesirable drainage patterns that develop during operations and revegetation of the reclaimed dump surface would minimize gully development after reclamation is completed.

Earthquakes

A strong earthquake within 10 miles of the project could create peak ground acceleration of between 40 and 50 percent of gravity (Algemissan and Perkins in Qamar and Brenninger, 1979; Bolt and Abrahamson, 1983). Because construction standards for proposed buildings are not given in the project application, it is not known to what standards the buildings would be designed and built. The mill facility is of particular concern because of the potential for a spill into the environment. Buildings not constructed to accepted earthquake standards would pose both a safety and environmental hazard, such as loss of milling fluids from the building (see Mitigating Measures).

The tailings would remain reasonably dry throughout construction and thereafter. Even a large earthquake centered near Jardine would not cause slump failure, piping, or liquifaction of the tailings dump. The dump would remain stable because of its design and construction. A berm around most of the dump would remove runoff water and provide lateral support for the tailings dump. The tailings would be deposited in the dump in a dewatered state and kept that way by an underdrain system at the bottom of the dump. The top of the dump would be covered incrementally with clay and topsoil, and revegetated to limit infiltration of precipitation. Without appreciable water buildup, the tailings would never fail in mass, even during a strong ground-shaking event.

A strong earthquake near Jardine could, however, cause settlement within the dump and in the underlying unconsolidated materials. Differential settlement could compromise the integrity of the double-liner system at the bottom of the dump or the single-clay cap at the top. Because all fluids in the dump cannot be removed, offsets could allow tailings water to seep into the underlying, unconsolidated, valley fill deposits.

The applicant has committed to incorporating an automatic control valve system into the tailings slurry/return water pipeline network to allow for rapid shutoff of the system in case of pipeline failure. In addition, the applicant has committed to using flexible pipe, such as polyurethane, which would resist failure during even strong ground-shaking. Ditches constructed beneath the pipelines would collect and direct any tailings slurry lost to adequately sized collection ponds. The amount of slurry water lost to seepage into the ground during a pipeline failure would be an insignificant amount.

Subsidence

Although difficult to predict, it is unlikely that extensive expressions of underground collapse would be evident at the surface. Rock within the mine would ravel from the sides and top and limit subsidence to shallow overburden areas. The applicant would leave blocks of bedrock within the mine, which would help minimize collapse features and surface subsidence. Signs of underground collapse could eventually reach the surface, but would probably be shallow and spread out over a fairly large area. Such changes would not affect the utility of the land surface nor create a hazard.

Mineral Hill is already honeycombed with past underground mining. All but one of the mine portal entrances have collapsed due to rotted timbers. The applicant could be required to backfill the abandoned mine entrances with waste rock when mining is completed. Backfilling of the mine entrance would help minimize the surface evidence of any tunnel collapse, but would not prevent it entirely. Mineral Hill is covered by up to 150 feet of glacial material on the Bear Creek side of the mountain. Some minor settling may occur at the surface in the zone where the access tunnels and underground excavations are not backfilled and the overburden thickness is relatively shallow.

Mitigating Measures

--To stabilize the diversion channel of the tailings dump, the upper, gentler segment of the channel would be covered with small-sized riprap (nominal size 6 to 10 inches) and the lower, steeper segment with larger (nominal size 50 inches) riprap. An alternative would be to lessen the channel gradient by slightly modifying the shape of the dump and by moving the dump a few hundred feet further upstream (northeast).

--To meet safety standards, the mill building would be constructed to withstand a peak horizontal acceleration of 50 percent of gravity.

HYDROLOGY

Summary: The maximum quantity of water required by the project would be about 3.31 cubic feet per second. However, during winter low flows, the maximum consumption would equal 0.65 cubic feet per second. This quantity of water would be withdrawn from Bear Creek and would deplete the stream by a factor of 0.5 percent during periods of low flow. This depletion could potentially affect the amount of water available to maintain minimum instream flows depending on the outcome of the present adjudication process.

Soil erosion and sediment loading to Bear Creek are predicted to increase during construction and approach baseline levels by year three. Actual concentrations of total suspended sediment in Bear Creek would depend largely on prevailing weather conditions.

Sewage generated by the project would be treated by a septic-tank drainfield system located 500 feet from Bear Creek. A small increase in the concentration of total nitrogen would be expected in Bear Creek below the drainfield site.

Two historic tailings impoundments would be removed and placed within the proposed tailings dump. This action would result in a decrease in the loading of cyanide, arsenic, and other heavy metals to the ground water system and Bear Creek.

Surface Water

Water Availability. The proposed project would require both potable and mill circuit make-up water. The total depletion associated with project operation would not be greater than 3.31 cubic feet per second. Peak consumption during winter low-flow periods would not exceed 0.65 cubic feet per second. These depletions would not affect existing uses of water from Bear Creek, assuming the project receives a pre-1978 priority date during the current statewide water rights adjudication process. However, if the Montana Water Court assigns the project a post-1978 priority date, already-established, minimum-instream flow requirements would preclude further depletion of Bear Creek at least 8 out of 10 years.

Homestake Mining Company has submitted 25 water rights claims on Bear Creek totalling 201.6 cubic feet per second (Department of Natural Resources and Conservation, 1985), or about 60 times as much water as is needed to satisfy the requirements of the proposed project. The outcome of the adjudication process is uncertain at this time. However, impacts to existing water rights holders or to the existing environment associated with a total depletion of 0.073 cfs would be insignificant.

Sediment Yield. Construction of the new mine road, as well as surface disturbances at the proposed project site, are potential sources of soil erosion and increased sediment loading to Bear Creek. The potential for erosion was assessed and sediment loading below the project area was predicted. Predictions presented in table III-1 are intended to indicate trends or to compare management alternatives. To a lesser extent, they may provide quantified estimates of sediment yield.

Table III-1: Predictions of Sediment Yield (Tons/Year)

Impact to Bear Creek		Impact to Yellowstone River	
Year	Tons/yr	Year	Tons/yr
1	5,775	1	6,719
2	243	2	495
3	68	3	138
4+	68	4+	138

Results indicate that sediment loading to Bear Creek would be greatest during the initial construction period and would approach baseline conditions by the third year. The quantity of sediment reaching Bear Creek would be greatest during periods of spring runoff, and may approach concentrations between 4 and 140 milligrams per liter above baseline levels. Actual concentrations would depend largely on prevailing weather conditions as well as the effectiveness of the erosion control practices employed.

Sewage Disposal. Sewage generated by the operation is projected to be about 3,850 gallons per day and would be treated by a septic tank drainfield system. The drainfield site would require an area of about 26,000 square feet based on a loading rate of 1.2 gallons per day per square foot. The drainfield site would be located about 500 feet from Bear Creek. Final drainfield design must satisfy standards developed by the Department of Health and Environmental Sciences (1984).

Total nitrogen is expected to increase in Bear Creek below the drainfield site (see table III-2). Properly constructed, the septic tank drainfield system would have minimal water quality impacts to Bear Creek.

Table III-2: Predicted Nitrogen Loading to Bear Creek During Periods of Winter Low Flow*

Assumptions:	
Bear Creek low flow:	5 cfs
Point source discharge:	3,850 gallons/day
Treated waste concentration:	32 mg/l of nitrogen
Baseline conditions:	
Total ammonia:	<0.10 to 0.24 mg/l
Nitrates and nitrites:	<0.05 to 0.11 mg/l
pH:	7.8 to 8.25
Temperature:	0.8° to 1.1° Centigrade
Predicated impact:	
Total nitrogen (N):	0.038 mg/l

*Worst-case analysis below proposed drainfield site.

Relocation of Existing Tailings. From the fifth to tenth years of operation, the two existing tailings impoundments would be removed and placed within the proposed tailings dump. The old tailings from the small impoundment may be reprocessed at the mill before placement in the disposal facility (Steffen Robertson and Kirsten, 1984). Both existing impoundments are sources of ground water pollution. Ground water studies indicate that contaminants from the existing impoundments move downgradient toward Bear Creek (project application, 1984). Reclamation of the old tailings impoundments would result in a decrease in the loading of cyanide, arsenic, and heavy metals to the ground water system. Therefore, concentrations of these constituents would be expected to decrease in Bear Creek through time.

Several sources of arsenic contamination would be removed during construction of the proposed project (see Chapter III--Cultural Resources). This action would result in a decrease in the concentration of arsenic in Bear Creek. However, this concentration would most likely continue to be greater than naturally occurring levels due to the leaching of buried wastes along the creek (Larry Brown, Dept. of Health and Environmental Sciences hydrologist, pers. comm., March 3, 1985).

Ore Processing Reagents. A list of reagents that would be used in the milling process is presented in table III-3. A description of these reagents and their relative toxicity to humans and the environment is presented in appendix 11 Tailings generated from the ore beneficiation process would be backfilled in mine stopes (40 percent) and deposited in a sealed impoundment (60 percent). Potential levels of total cyanide draining from tailings following deposition could be as high as 1.31 mg/l (project application, 1984). At pH 5 the concentration of arsenic could be as high as 3.7 mg/l.

Table III-3: Ore Processing Reagents and Rate of Application Based on a Production Rate of 750 tons of Ore Per Day

Reagent	Application rate (pounds/day)
Sodium cyanide	21*
Aerofloat 208	38
Aero 350 xanthate	105
Aerofroth 76	113
Separan NP10	75

Source: Project application.
*Based on a 20:1 ore to concentrate ratio (Olin Hart, Homestake Mining Company geologist, pers. comm., March 19, 1985).

The potential for contamination of the environment by ore processing reagents and tailings would be reduced by the applicant's proposed tailings dump design, low permeability of the mine workings, and emergency spill contingency plans. Tailings would not be dewatered before backfilling; however, slurry water from the backfilled tailings would be controlled by ditches in the mine, collected in underground sumps, and pumped back into the mill circuit.

The slurry and backfill lines would be monitored by daily visual inspections and by continuous balancing of flow at the mill and process area to check for leaks. If a leak were detected, the system would be shut down. The slurry and backfill line pads would contain the spill, and employees using on-site equipment would clean up the spill. With the exception of the sand backfill lines to the mine, pipeline pads would consist of slurry pipelines fixed to a support built on a 14-foot-wide trench. The trench would be unlined, with a crest of one foot and a slope of 0.04 percent (project application, 1984).

If the slurry and return water system were shut down, provisions would be made for the pressure portion of the lines to drain back to the mill or divert into the 1,050 level of the mine. The gravity section would drain to the process area. The slurry and backfill lines would be free flowing; therefore, freezing would become a serious problem when the system is inoperative (project application, 1984).

Prevailing weather conditions, final design characteristics of the slurry and backfill line pads, and the efficiency of emergency shut-down procedures would determine the potential for contamination of surface water resources. The major concern during a spill would be sediment loading to Bear Creek.

Water Quality Monitoring. Five factors have been taken into consideration in designing an operational surface water monitoring program.

--The proposed project is located in an environmentally sensitive area.
--Arsenic contamination related to previous mining activities is well documented.
--The proposed ore beneficiation process could use the potentially toxic chemical sodium cyanide.
--Increased sediment loading to Bear Creek would be expected.
--A septic tank drainfield system would be built near Bear Creek.

The operational surface water quality monitoring program would be based on an evaluation of these factors. Operational monitoring would occur at stations 001A and 010 (see figure II-4) for each year of operation unless otherwise noted. The parameters and frequency of sampling are presented in appendix 15.

Ground Water

Potential Sources of Ground Water Contamination. The type and concentration of substances in solution that might be expected from leaching of tailings were estimated for the proposed project by performing a batch extraction test at pH 5 on pilot plant test tailings (Steffen Robertson and Kirsten, 1984). Data presented by the applicant indicate the tailings effluent should have moderately high pH and high total dissolved solids. Leachate from the batch extraction test contained elevated levels of cyanide as free cyanide, arsenic, and manganese. Results of the batch column test are presented in table III-4 (Steffen Robertson and Kirsten, 1984). Although these test results cannot accurately predict the expected water quality of the seepage and return water ponds, they can be used to identify parameters that may exist in concentrations above established quality criteria.

Table III-4: Chemical Analysis of Batch Test Leachate and Supernatant

Parameter	Leachate (1:1 extraction ratio at pH 5) (mg/l)	Supernatant (mg/l)
Total dissolved solids	600	550
Sulfate	145	195
Free cyanide	0.14	<0.05
Iron	0.08	0.12
Arsenic	3.7	1.8
Chromium	<0.01	<0.01
Copper	<0.01	<0.01
Manganese	0.07	0.02
Nickel	<0.05	<0.05
Zinc	<0.01	<0.05

Source: Steffen Robertson and Kirsten, 1984.
Concentrations in milligrams per liter.

There are two potential sources of ground water contamination. One is direct seepage from the tailings dump. The other is the production of leachate in mine workings and backfill that could percolate through bedrock fractures to the Bear Creek alluvium.

The potential for seepage through the tailings dump and subsequent contamination of the alluvial ground water system was evaluated. Results of this evaluation indicate that, if properly constructed, a seepage control system comprised of natural foundation material mixed with bentonite, overlain by a synthetic membrane liner on which a drainage system is placed, would effectively prevent seepage from entering the ground water system (United States Environmental Protection Agency, 1974). During the life of the mine, the drainage system would collect and recycle any leachate percolating down through the tailings. Reliability of liner performance after final reclamation would not be an issue because reclamation would effectively limit recharge through the tailings dump.

Commitments by the JJV would effectively reduce the potential for contamination by seepage through fractures and faults. These commitments include: 1) all tailings from the more toxic, cyanide-agitation circuit would report to the lined impoundment, 2) all ditches and sumps in the mine would be lined, 3) grouting would be performed in the mine to stop the flow of water, and 4) the last two feet of sand backfill would be mixed with cement to create a hard, impermeable surface.

Acid-mine Drainage. For acid-mine drainage to occur there must be a source of 1) sulfide mineral (generally pyrite), 2) oxygen, and 3) water. The physical characteristics of the mine itself must interact to produce acid and then allow it to drain from the mine (USDA Forest Service, 1980). If any one of these three factors is absent, acid drainage cannot occur.

Information provided by the applicant suggests that the availability of water in the mine workings would limit acid drainage. Previous mine development established eight working levels in Mineral Hill between elevations of 6,601 feet and 7,113 feet. The existing workings do not produce appreciable amounts of water; however, a small seep near a portal at 6,601 feet produces a few gallons per minute (Olin Hart, Homestake Mining Company geologist, pers. comm., March 19, 1985). The applicant has proposed five new working levels between 7,263 feet and 6,663 feet. Therefore, the lowest proposed level is about 62 feet above the only documented source of water and 150 feet above Bear Creek.

Water Quality Monitoring. Baseline ground water quality data have been collected from a network of eight monitoring wells (figure II-6). Six of these wells are located downgradient of the proposed tailings dump site; one is beneath the site; the other is upgradient near the proposed mill site.

Design and Reclamation of the Tailings Disposal Facility. The hydrology of the project site has a major input in the design and operation of the tailings disposal facility. The proposed method of dewatered tailings disposal requires that the tailings remain dry after deposition. Therefore, a series of water balance calculations were performed that considered seasonal and annual variations and flood events in conjunction with a range of operating conditions (Steffen Robertson and Kirsten, 1984).

Tailings would be reclaimed in stages as material is deposited in the impoundment in a manner that should keep the total area exposed to the environment to a minimum. The main source of water coming into contact with the tailings is from direct precipitation on the unreclaimed portion of the impoundment known as the "active area."

Hydrology Cumulative Impacts

Logging

The U.S.D.A. Forest Service's small-sales program of logging 25 acres per year is a potential source of soil erosion and increased sediment loading to Bear Creek. The potential for erosion was assessed and sediment loading at the mouth of Bear Creek was predicted. Predictions presented in table III-5 are intended to indicate trends or to compare management alternatives. To a lesser extent, they may provide quantified estimates of sediment yield.

The cumulative long-term impact of the proposed mine and clearcuts would be that sediment concentrations in Bear Creek at the mouth would increase about 6 percent. By the year 1997, the proposed timber sales would be responsible for less than 1 percent increase in background sediment concentrations. The implications of these predictions are discussed in Chapter III--Aquatics.

Hydroelectric Power Generation

In December 1984, Enco Development Corporation (P.O. Box 5663, Bellingham, Washington 48227) filed a preliminary permit application with the Federal

Energy Regulatory Commissioner (FERC) to develop a 400-kilowatt hydroelectric facility in the Bear Creek basin. The FERC public comment period for Bear Creek Project #8832-000 ended in October 1985. This project would make use of an existing concrete diversion; a 10,000-foot ditch; a 3,000-foot penstock; and a 2-mile long, 50-kilovolt transmission line which would tie in with the existing Montana Power Company line. Details regarding Enco's application for a preliminary hydropower permit from the Federal Energy Regulatory Commission are reproduced as appendix 17. A preliminary permit does not authorize construction. However, it does allow the applicant to proceed with feasibility studies by obtaining site control.

DSL contacted Mr. Kenneth R. Koch, Enco Development Corporation, regarding the Bear Creek hydropower project (pers. comm., January 20, 1986). Mr. Koch indicated that recent tax law changes affecting small-scale hydropower operations would most likely render this project financially infeasible.

Without any design information, it would be very difficult to accurately predict project water requirements. However, assuming 880 feet of operating head (Kenneth R. Koch, Enco, pers. comm., January 20, 1986), 1 400-kilowatt plant would require less than 10 cubic feet per second of flow.

Mitigating Measures

- --To prevent potential problems during a spill, oil petroleum products, industrial chemicals, and similar toxic or volatile materials would be stored in durable containers in an area surrounded by impermeable containment structures.
- --EPA criteria were evaluated with regard to the placement of existing wells, the high cost of well construction, the uncertainty involved in determining ground water flow patterns, and the design of the proposed tailings dump. Based on this evaluation, the operational monitoring program should consist of the eight existing baseline monitoring wells augmented by additional wells and monitoring the unsaturated zone. The applicant would be required to submit an operational ground water monitoring plan which adequately monitors for seepage under the return water pond, sludge ponds, and seepage collection pond, as well as under the lined tailings dump. Although mining wastes are not classified as hazardous under current environmental laws, hazardous materials would be disposed of in the lined tailings dump. For these reasons, the ground water monitoring program should conform with State of Montana guidelines developed for ground water monitoring of hazardous wastes.
- --An active area of less than six acres would reduce seepage and maintain confidence in the impoundment's ability to handle catastrophic precipitation/snowmelt events. A small active area would also help mitigate problems associated with wind erosion of exposed tailings.
- --After all residual solutions have drained from the tailings, both the seepage collection pond and return water pond would be filled with bank material and reclaimed.

Table III-5: Predicted Increase in Sediment Yield to Bear Creek in Tons/Year

Activity	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Natural sediment yield	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550	550
1982 baseline conditions (assumed constant)	1,191	1,191	1,191	1,191	1,191	1,191	1,191	1,191	1,191	1,191	1,191	1,191	1,191	1,191	1,191	1,191
Jardine Mine and new road (1986)	5,775	243	68	68	68	68	68	68	68	68	68	68	68	68	68	68
Forest plan clearcuts (25 acres/year for 10 years)																
Roads:		192.0	51.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	5.0	5.0	5.0	5.0	5.0
Logging year 1:		3.3	1.7	1.4	0.9	0.4	0.2	0.0								
Logging year 2:			3.3	1.7	1.4	0.9	0.4	0.2	0.0							
Logging year 3:				3.3	1.7	1.4	0.9	0.4	0.2	0.0						
Logging year 4:					3.3	1.7	1.4	0.9	0.4	0.2	0.0					
Logging year 5:						3.3	1.7	1.4	0.9	0.4	0.2	0.0				
Logging year 6:							3.3	1.7	1.4	0.9	0.4	0.2	0.0			
Logging year 7:								3.3	1.7	1.4	0.9	0.4	0.2	0.0		
Logging year 8:									3.3	1.7	1.4	0.9	0.4	0.2	0.0	
Logging year 9:										3.3	1.7	1.4	0.9	0.4	0.2	0.0
Logging year 10:											3.3	1.7	1.4	0.9	0.4	0.2
TOTAL INCREASE	5,775	438	124	89	90	91	91	91	91	91	91	78	76	75	74	73
Increase as a percentage over baseline conditions	485%	37%	10%	8%	8%	8%	8%	8%	8%	8%	8%	7%	6%	6%	6%	6%

AQUATICS

Summary. Increases in total suspended sediment (TSS) and total nitrogen in Bear Creek would have little effect on aquatic insect and algal communities. Changes, if any, would be temporary, and recovery would be rapid. Small reductions in streamflow would not significantly reduce habitat for aquatic organisms.

The project would not physically alter the channel or substrate of Bear Creek. All mining, milling, and tailings disposal activities would occur away from the creek. There would be no direct discharges of mine-related wastewater into the creek.

Project water requirements (see Chapter I) would slightly reduce habitat for aquatic organisms. Mining could cause flows to fall below minimum instream flow requirements (Peterman and Nelson, 1985) in September and December. However, these estimated deficiencies would be minimal (see appendix 25). Furthermore, baseline flows in Bear Creek occasionally fail to meet flow requirements.

Surface erosion on the project area and seepage from the septic system drainfield would increase TSS and total nitrogen in Bear Creek. TSS in Bear Creek during spring runoff may increase about 500 percent during construction. These levels would decrease to near-premining concentrations by year three (table III-5). Total nitrogen concentrations would increase only slightly below the drainfield site in Bear Creek.

Elevated concentrations of TSS during the initial years of the project may cause a decrease in macroinvertebrate density in Bear Creek below the project, but the diversity of organisms is not likely to change significantly. Gammon (1970) and Ingman et al. (1984) indicate that increased TSS has similar effects on all insect taxa.

Few pools (depositional areas) have formed in Bear Creek because of its steep gradient. Webster et al. (1983) found that these pools were the most adversely affected by suspended sediments. Therefore, the effects of suspended sediment on aquatic macroinvertebrates in Bear Creek would be limited. Because the general substrate would be unaffected (it would remain as coarse gravels with cobbles and boulders), macroinvertebrate populations would recover unimpeded once TSS concentrations approximated baseline conditions. Depending on weather conditions and mitigating measures (see Chapter III--Hydrology, Construction) implemented by the applicant, potential impacts from sediment could be substantially reduced.

The slight increase in total nitrogen concentrations would not adversely affect macroinvertebrates or algal communities.

Cumulative Impacts

Logging the Parker-Eagle and Pine Creek clearcuts would probably not have any greater effect on the aquatic life of Bear Creek than the mine itself, although TSS concentrations would generally be greater. The timing and transport of sediment would be similar to that described for the project proposal. Potential impacts from sediment could be substantially reduced with reasonable soil, water and land conservation practices applied during and after logging (see Chapter III--Hydrology, Mitigating Measures). The uncertainty of the development and design of the Enco hydroelectric project does not allow for predicting impacts to aquatic life in Bear Creek.

FISHERIES

Summary: The concentrations of total suspended solids (TSS) and total nitrogen in Bear Creek are predicted to increase as a result of mining activities (see Chapter III--Hydrology). However, these increases would be insignificant and are not expected to adversely affect the fishery. Slight decreases in streamflow would have negligible impacts on trout.

Total Suspended Solids (TSS). Baseline concentrations of TSS at the mouth of Bear Creek during the 1981-1982 sampling period ranged between 1 and 13 milligrams per liter (mg/l). During project construction, the concentration of TSS may approach 140 mg/l over baseline. The actual concentration will depend on prevailing weather conditions and the effectiveness of erosion control practices employed.

This temporary increase in TSS is not expected to adversely affect the Bear Creek fishery. While no precise maximum concentration of suspended solids has been proven detrimental, Newport and Moyer (1974) determined that streams with sustained concentrations of between 100-400 mg/l were unlikely to support a good fishery. R. Liepolt reported that a trout fishery exists in a stream usually containing 19 to 23 mg/l of suspended solids. This fishery was not harmed by dredging operations that raised the concentration to about 160 mg/l for short periods (in European Inland Fisheries Advisory Commission, 1975).

Temporary increases in TSS would most likely occur during early spring, while rainbow x cutthroat spawning activities occur during mid-summer. Bear Creek is a high gradient stream; the majority of sediment would probably flush through and dilute in the Yellowstone River. For these reasons, project activities would probably not affect the fishery or fish spawning in Bear Creek. Sediment released as a result of logging activities would have an effect on fish similar to the effect on aquatic insects and algae (Chapter III--Aquatics, Cumulative Impacts).

Nitrogen. The predicted increase in nitrogen loading is extremely small and concentrations of total nitrogen would be well below the quality criteria established for cold water aquatic life; therefore, no impact from nitrogen is expected.

Flow Reduction. Flows in Bear Creek would be slightly reduced by mining (see Chapter III--Hydrology). This reduction would probably remove an insignificant amount of trout habitat. Reduced flows could fall below minimum instream flow requirements for Bear Creek (Peterman and Nelson, 1985). However, the deficiencies would be small and would not occur during trout spawning (see appendix 25). Even under baseline conditions, Bear Creek occasionally falls short of flow requirements. The Enco hydroelectric dam could further reduce flows in Bear Creek. However, the uncertainty of its development does not allow for impact analyses.

SOILS

Summary: Biological impacts would occur in soils stored for prolonged periods. These impacts include a reduction or loss of soil microorganisms important to plant growth and nutrient cycling, a breakdown of soil structure, a reduction in organic matter, a loss of soil nutrients, and a loss of native seeds and other potentially active vegetative parts. Until vegetation is established, soil erosion would be moderate on the steep waste rock dump slopes, and minimal in other disturbance areas. Plant toxicity problems due to the chemical characteristics of soils or underlying waste materials are not expected.

Soil Quantity

The applicant would salvage a minimum of about 136 acre-feet of soil from the proposed disturbance area (table III-6). This would provide an average soil cover depth of at least 18 inches during reclamation. Actual replaced soil depths would vary depending on the type of disturbance. For example, soils would be replaced at a total depth of about 25 inches on the tailings dump, whereas soils on the five small waste rock dumps and in the facilities area would be replaced at a minimum depth of about six inches. Two factors that determine the necessary replacement soil depth include 1) the potential toxicity to plants from the underlying waste materials or, 2) in the case of the facilities area, the suitability of the subsoils for plant growth.

As mentioned above, the total soil volume of 136 acre-feet is the minimum amount expected to be salvaged. Although not shown in the table, an unknown amount of salvageable soil exists in the 26 acres mapped as "disturbance" in the soil survey (figure II-9). The disturbance mapping unit includes material such as old tailings and waste rock with no soil, but also includes the area in and around the Jardine townsite where the proposed facilities (mill, laboratory, warehouse, parking lots, etc.) would be located. The applicant's reclamation supervisor would identify any salvageable soils in this area before construction begins. These soils would be stockpiled next to the facilities area and would remain in place for the life of the operation. The applicant's plan to salvage favorable soil material located within the disturbance mapping unit would increase the estimated total soil volume given in table III-6.

Table III-6: Soil Resources of the Proposed Disturbance Area

Soil mapping unit[1]	Acres proposed for disturbance	Percent of total disturbance area	Proposed total salvageable depth (inches)	Estimated salvage volumes (acre-feet)	Percent of total salvageable volume	Primary limiting factors
A--very gravelly loam, 40-60%	10.0	10.8	12[3]	10.0	7.3	Steep slopes, excess coarse fragments
A1--very gravelly loam, 30-50%	6.0	6.4	60	30.0	22.0	Steep slopes, excess coarse fragments
B--gravelly sandy loam, 15-25%	3.6	3.9	--[4]	--[4]	--[4]	Trace element contamination, excess coarse fragments
E--gravelly sandy loam, 13-25%	30.5	32.8	24	61.0	44.7	Excess sand, excess coarse fragments
M--fine gravelly sandy loam, level	13.7	14.7	30	34.3	25.2	Excess coarse fragments
S--very gravelly sandy loam, 10-20%	2.1	2.3	6	1.1	0.8	Excess coarse fragments
Est--gravelly sandy loam, 50-70%	0.9	1.0	0	0.0	0.0	Steep slopes, excess coarse fragments
Disturbed areas[2]	26.1	28.1	--[2]	--[2]	--[2]	See footnote 2
TOTALS	92.9	100.0	NA	136.4	100.0	

Source: The above data was extrapolated from the Jardine Joint Venture permit application, 1984.

[1] Soil names are not official; they are used for reference only. Percentage figures following mapping unit names represent slope ranges where unit is found.

[2] Disturbed areas include old mine waste disposal areas, mine-related disturbances, and the Jardine townsite; some soils are intermixed with these disturbances and would be salvaged to a depth of at least 6 inches under the proposed plan. These areas would be identified in the field by the applicant's reclamation supervisor.

[3] For calculation purposes, it is assumed that type A soil would be salvaged to an average depth of 12 inches; however, actual salvage of this soil would vary between 6 and 20 inches depending on steep slope and coarse fragment limitations.

[4] Type B soils would not be salvaged in the vicinity of the proposed tailings pond; they have been chemically contaminated by the existing unreclaimed tailings. However, small areas of this soil type exist in areas proposed for new roads and slurry lines, and this soil would be salvaged in these areas to a depth of at least 6 inches.

Soil Salvage Plan and Soil Quality

The applicant proposes to salvage soils in one lift, with the exception of two soil types located in the proposed tailings dump area. These soils (types E and M) would be salvaged in two lifts; the separation of the two lifts would be based on the amount of coarse fragments (gravels and cobbles). The first lift (surface layers) would contain less than 45 percent fragments by volume. The second lift (subsoil material) would contain greater than 45 percent fragments. The purpose of the two-lift procedure in the tailings dump area is discussed later (see Tailings Dump section).

The salvageable soils in the proposed permit area are described in Chapter II--Soils. Trace elements are low in soils proposed for salvage; therefore, no plant toxicity problems are expected. Most of the soils have a high-sand and coarse-fragment content. Generally, this would indicate that the soils have low water- and nutrient-holding capacities. These characteristics could cause problems with plant establishment on the reclamation areas. However, the organic matter content of the soils in the areas proposed for disturbance ranges from moderate (1.3 percent) to very high (12.0 percent) in the surface 12 inches, with an average in the high range (4.3 percent) (see table III-7). Because of the high organic matter content, postmining water- and nutrient-holding capacities are expected to be adequate for revegetation, especially in the areas where soils are hauled directly (removed from one area and immediately respread over a reclamation area without stockpiling).

Table III-7: Organic Matter Content of the Surface 12 Inches of Jardine Project Soils

Soil type	Sample number	Weighted average organic matter content, surface 12 inches (percentage)
A	SS-21	1.9
A	SS-8	4.6
A1	SS-28	5.3
B	SS-6	7.1
B	SS-14	12.0
E	SS-22	1.8
E	SS-10	1.3
M	SS-11	3.8
M	SS-11A	3.8
S	SS-15	1.7
S	SS-18	4.1

Source: The above data was derived from the Jardine Joint Venture permit application, 1984.

About 55 percent of the soils would be hauled directly; the remainder would be stored in stockpiles for at least 10 and possibly more than 21 years. The applicant's plan to direct-haul as much soil as possible would enhance the revegetation effort. Spread immediately over graded waste material, freshly stripped soil contains a number of favorable components. These components include native plant seeds, rhizomes (underground stems) and other vegetative parts that grow after transport, and important soil microorganisms such as bacteria, fungi, and algae (Iverson and Wali, 1982; Howard and Samuel, 1979; Schafer, 1979; Beauchamp et al., 1975). These microorganisms play an essential part in decomposition and soil/plant nutrient cycling.

Other important constituents transported in directly hauled soil are mycorrhizae--structures that develop when certain fungi and plant roots form a symbiotic (mutually beneficial) relationship. The fungi absorb nutrients and water for the plants and the plants provide carbohydrates from photosynthesis for the fungi. In essence, the mycorrhizae serve as highly efficient extensions of the plants' roots. These organisms are an important consideration in maximizing plant productivity; most plants depend on them for adequate growth and survival. Malloch et al. (1980) state that four-fifths of all land plants form mycorrhizal relationships; some plants cannot succeed without this fungal associate (Trappe, 1981). Mycorrhizae reportedly increase plant productivity by as much as 400 to 500 percent (Davidson, 1976; Mosse and Hayman, 1971; Gerdemann, 1970). It therefore becomes clear how these organisms, as well as other components of directly hauled soil, assume important roles in the reestablishment of vegetation on disturbed lands.

Effects of Soil Storage

Some of the disturbances proposed at the minesite cannot be reclaimed until after the mine closes. These disturbance areas include the facilities area buildings, yards and parking lots, part of the tailings pond, mine roads and corridors, sediment control structures, the ore stockpile area, and the adit yards and associated waste rock dumps. Because of this, some of the soil salvaged during the construction phase of the mine would be stored in stockpiles for up to 21 years or more. The soil stockpiles would be stabilized with hydromulch and a seed mixture containing three grasses and one forb. This would prevent any excessive soil loss from the stockpiles due to wind or water erosion during the life of the operation.

Soil deteriorates when it is stored for prolonged periods, and may have little biological resemblance to native soils. Important soil microorganisms such as bacteria, fungi, algae, and mycorrhizae (discussed above) are greatly reduced in quantity or completely eliminated (Doerr et al., 1984; Fresquez and Lindemann, 1982; Liberta, 1981; Rives et al., 1980; Cundell, 1977; Miller and Cameron, 1976). The most common cause of reduced biological activity is the anaerobic (oxygen-free) condition created in the deeper portions of the soil stockpile (McKell, 1982).

In addition, prolonged soil storage causes breakdown of soil structure, affecting water and air movement through the soil, and reduces the organic matter content, which in turn decreases the water- and nutrient-holding capacity. Soil storage increases nitrogen losses and reduces the availability of other important plant nutrients due to a decrease in nutrient mineralization (Fresquez and Lindemann, 1982; Singleton and Williams, 1979; Davidson, 1976; Miller and Cameron, 1976). Seeds and other potentially active vegetative parts contained in the soil are also adversely affected (McKell, 1982).

Some of the adverse effects of prolonged storage would be offset by: 1) the relatively small size of the various disturbances proposed to be reclaimed with stored soil, 2) the naturally high organic matter content of the soils in the area, and 3) soil amendments proposed by the applicant in the reclamation plan.

Aside from the tailings dump, which is discussed later, the other mine-related disturbances are relatively small in size, ranging from 0.1 acre for the air shaft up to 12.0 acres for the facilities area. Because these are small, scattered disturbances, important soil microorganisms would naturally reinvade the replaced soils from adjacent, undisturbed sites in a relatively short period of time. Mycorrhizal fungi could reinvade these sites within one to three growing seasons. This estimate is based on research in Wyoming where reinvasion took somewhat longer, but the disturbances were larger and the sites drier (Loree and Williams, 1984a; Allen and Allen, 1980). Other types of soil microorganisms would probably reestablish quicker than the mycorrhizae, based on the work of Lindemann et al. (1984) and a review by Loree and Williams (1984b).

The applicant proposes to add two tons per acre straw mulch or one ton per acre hydromulch to the replaced soils. Other organic mulches (such as sewage sludge, wood chips, and manure) may also be added depending on availability. In addition to the residual organic matter remaining in the soil after storage, the proposed organic amendments would aid in the reestablishment of soil microorganism populations (Lindemann et al., 1984). To a more limited extent, the organic amendments could also enhance the formation of mycorrhizae (Zak et al., 1982). Postmining water- and nutrient-holding capacities, although lower than in directly hauled soils, are expected to be adequate for vegetation reestablishment based on the proposed organic amendments in combination with any residual organic matter remaining in the soils after storage.

The applicant proposes to fertilize the replaced soils at a rate to be determined by sampling and analysis during reclamation. Fertilization would replace nutrients in the soil that have been lost during prolonged storage. The loss of seeds and other potentially active vegetative parts due to soil storage would be somewhat mitigated by the applicant's proposed revegetation plan (see Chapter III--Vegetation). However, vegetative species diversity would be lower than premining levels on soils that have been stored. Diversity would increase with time as plant species not included in the revegetation plan invade from adjacent, undisturbed areas (see Chapter III--Vegetation).

Tailings Dump

For the purpose of this evaluation, it is assumed that the tailings produced by the proposed operation would be chemically and physically similar to the existing tailings at the two abandoned ponds left from previous operations at the site. The existing tailings have a textural range between silt loam and sandy loam, and are low in coarse fragments.

Aluminum and arsenic are two elements of concern in regard to potential postmining plant toxicity. The average water-soluble concentrations of aluminum and arsenic in the existing tailings are about 25 and 13 parts per million (ppm), respectively. Total (as opposed to water-soluble) arsenic concentrations are several orders of magnitude higher, with an average total concentration of about 13,500 ppm, or 1.3 percent. The reason for the great difference in arsenic concentrations is that most of the total arsenic is in the form of arsenopyrite, which is not easily weathered. Arsenopyrite has a low solubility in water; therefore, very little is available to plants.

Aluminum can be toxic to plants at concentrations as low as two ppm (Gough et al., 1979). Aluminum toxicity generally does not occur in soils or other growth media with a pH above 5.5, but is common at lower pH values and particularly severe below a pH of 5.0, where the solubility of this element increases sharply (Foy, 1974; Kabata-Pendias and Pendias, 1984). Aluminum concentrations well above two ppm and pH values below 5.0 are common in the existing tailings, and would most likely be common in the proposed tailings.

Arsenic is known to be toxic to plants such as alfalfa and barley at concentrations as low as two ppm (Vandecaveye et al., 1936 in Gough et al., 1979). The National Research Council (1977) considers concentrations around five ppm toxic to other sensitive plants. Sandberg and Allen (1975) found that the toxicity of arsenic was greater in acid soils than those with an alkaline pH, but this relationship may be affected by interactions with other elements, such as phosphorus. Almost all of the existing tailings have arsenic concentrations above 2 ppm and pH values on the acid side of the scale. Similar properties are also expected in the applicant's proposed tailings.

Although cyanide would be used in the gold extraction process, only small concentrations of this compound (<0.05 to 1.3 ppm) would be found in the tailings dump. In certain forms, cyanide can be extremely toxic to plants as well as other living organisms. However, several factors would exist in the tailings dump that would render any residual cyanide harmless to postmining revegetation. Residual cyanide would be chemically bound with iron and many other metals in the tailings; its mobility would be quite limited. Cyanide would also react with various forms of sulfur present in the tailings and would form thiocyanate, a relatively nontoxic compound (National Science Foundation, 1983). After soils are replaced and microorganism populations reestablished, residual cyanide in the plant rootzone would be biologically converted to nitrogen compounds and carbonate or carbon dioxide (Towill et al., 1978; Strobel, 1967 as cited in National Science Foundation, 1983). Because of the above, no plant toxicity is expected to occur as a result of cyanide.

The tailings alone (without soil) could be toxic to plants due to excessive amounts of aluminum and arsenic as well as excess acidity. This is evident from observations of the larger existing tailings pond where no volunteer vegetation exists, even several decades after abandonment. A good cover of vegetation does exist where soil was spread on the smaller tailings pond near Bear Creek. However, at this site in 1979, the Anaconda Company pushed some very gravelly and cobbly sandy loam soil over the toxic tailings and seeded the area with a mixture of grasses and forbs. The site was also fertilized at that time, but no other reclamation activities have taken place since.

To take advantage of the several years of plant growth at the smaller site, and because little information is available in the literature regarding tailings pond reclamation in Montana, the applicant funded a study to evaluate the vegetation and the chemical and physical characteristics of the two existing ponds (Westech, 1984). The applicant's reclamation plan, in part, is based on that study.

The soil used by the Anaconda Company to reclaim the small pond is similar to the soils that would be used by the applicant to reclaim the proposed tailings dump. Soil depths at the reclaimed pond vary from 3 to 24 inches. As might be expected, vegetative production is greater over the deeper soils, although canopy cover and frequency of occurrence is similar over both soil depth extremes. The roots of all species spread horizontally upon reaching the soil/tailings boundary, and seldom penetrate more than a couple of inches into the tailings. Vegetation growing on the small tailings pond was chemically analyzed for nine trace elements. The results of this analysis were compared to published results. Based on this comparison, the trace element concentrations found in the vegetation are within normal ranges (Kabata-Pendias and Pendias, 1984; Munshower, 1983; Ebens and Shacklette, 1982; Gough et al., 1979; Shacklette, 1972; Wallihan, 1966; Brewer, 1966; Labanauskas, 1966; Vanselow, 1966; Chapman, 1966; Reuther and Labanauskas, 1966; Jones, 1961; Williams and Whetstone, 1940).

The success of the vegetation growing on the small reclaimed tailings pond is attributed to several factors. These factors can be used to evaluate the applicant's reclamation plan. The cover soil serves as an effective physical and chemical buffer between the plants and the tailings. Neither significant acidification nor contamination by trace elements by upward migration from the tailings occurred after several growing seasons. Upward migration of potentially toxic trace elements was probably prevented by the extreme difference in texture between the fine tailings and the coarse soil. In addition, the chemical characteristics of the underlying tailings are such that substantial root penetration is discouraged. With an adequate cover soil depth, deeper penetration by the roots is apparently not necessary to obtain adequate amounts of water and nutrients.

As discussed earlier, minor root penetration did occur. This may have resulted from a seasonal, temporary increase in the pH of the tailings surface at the soil boundary. Spring moisture probably penetrates rapidly through the coarse soil and saturates a zone around the soil/tailings boundary. This "waterlogging" may have caused the pH to rise (Etherington, 1982; Black, 1968). A rise in pH would make trace elements, such as aluminum, less available to the plants. This factor, along with the decrease in acidity, may have allowed some root penetration.

The applicant's reclamation plan expands on the techniques used by the Anaconda Company in 1979. Before placing salvaged soil over the tailings, the surface of the dump would be sealed by mixing one inch of bentonite clay with the top nine inches of tailings. After the bentonite application, the soils that have been salvaged in two lifts would be replaced in two lifts (see Soil Salvage and Soil Quality). The coarser subsoils would be placed on top of the tailings, and the finer topsoil would then be replaced at the surface. Because of the bentonite seal and the coarse subsoils, no significant upward migration of trace elements is expected; therefore, the cover soil would remain uncontaminated. Root penetration into the tailings of the proposed dump would probably be less than what has been observed in the small reclaimed pond. In addition to the chemical "barrier" created by the tailings, the mixture of bentonite and tailings would compact considerably under weight of the equipment used to respread the soils, seed, fertilizer, and mulch. The compaction would further discourage root penetration.

The applicant proposes to reclaim the tailings dump in five increments, leaving only about four to nine acres of exposed tailings at any one time. By doing so, soil can be directly hauled for reclamation over much of the dump. As discussed earlier, directly hauled soil promotes rapid revegetation and increases plant species diversity (see Chapter III--Vegetation).

Some erosion by water can be expected on the dump slopes, which are all about 33 percent. However, the applicant's proposed mulch treatment, along with the coarse-textured soils, would promote rapid infiltration and discourage runoff, preventing excessive soil losses. Where rills and gullies form on the newly revegetated area, the applicant would take corrective measures, including filling the rills and gullies, regrading, and reseeding. Soil erosion potential would decrease as vegetation becomes established.

Waste Rock Dumps

Five waste rock dumps are proposed, and would be located on the west side of Mineral Hill. The dumps would be next to the five mine portals, and would range in size from 1.5 to 2.1 acres. All five dumps would occupy a total of less than 10 acres.

Reclamation of the dumps would be conducted at the end of mining. However, if activities were complete at any of the four upper levels before the end of the operation, reclamation would begin at that time. Before soil redistribution, the slopes of the dumps would be reduced from 80 percent (the angle of repose), to between 50 and 67 percent. Soil that has been stockpiled next to each of the dumps would be spread over the dumps at a depth of at least 6 inches. Soil would be replaced at greater depths in areas where voids are created by larger rock fragments. The dumps would then be seeded, fertilized, and hydromulched (see Chapter III--Vegetation).

Waste rock has not been analyzed for any chemical parameters; however, no plant toxicity problems are anticipated. The waste rock is low-grade material mined through to access the ore (mineralized zone). Because the rock does not undergo any milling or processing, the trace elements are chemically bound within the rock and are not readily available to plants. This is evidenced by the old abandoned waste rock dumps on Mineral Hill where vegetation has naturally invaded without the addition of soil. The vegetation is sparse in some places, but this is attributed to the steepness of the slopes and lack of soil, not the rock chemistry.

Soil loss due to erosion would be likely to occur off of the steep (50 to 67 percent) dump slopes during the initial reclamation years. Erosion rates would be moderate overall, and would decrease significantly after vegetation becomes established. In the interim, excessive soil losses would be partially offset by the short slope lengths, the rock content of the dumps, and the coarse texture of the soils to be used in reclamation. In addition, any rills and gullies that form on the newly revegetated dumps would be filled, regraded, and reseeded.

The applicant proposes to use hydromulch at a rate of 1,000 pounds per acre on the surfaces to aid in erosion control, soil moisture retention, and to increase organic matter. However, hydromulch alone is not very effective in controlling erosion. Hydromulch must adhere to the soil and hold the seed in place during heavy rainfall impact and wind; if it fails to do so, the other beneficial characteristics of the mulch are unimportant (Kay, 1980). Although not proposed by the applicant, the addition of a tackifier or erosion-control chemical would increase the effectiveness of the mulch.

The impacts of prolonged soil storage were discussed earlier (see Effects of Soil Storage), and would apply to the waste dump soils because they would probably be stockpiled for the life of the operation. However, because of the small size of these dump areas, important soil microorganisms would quickly invade from adjacent, undisturbed sites, improving soil quality. Plants not included in the revegetation mixture would invade from adjacent areas and would increase species diversity (see Chapter III--Vegetation).

Facilities Area

The facilities area would be the easiest to reclaim of all the disturbances due to the gentler slopes (10 to 20 percent) and because the proposed disturbances (buildings, stockpiles, parking lots) are much less drastic than at the tailings and waste rock dump sites. When mining activities are finished, the structures would be removed and the area would be graded and ripped to relieve compaction. Soil stockpiled next to the facilities area would be respread at a depth of about six inches. The area would then be seeded, fertilized, and mulched with straw at a rate of two tons per acre. The straw would be crimped vertically into the soil (see Chapter III--Vegetation). Because of the gentler slopes and the proposed crimped mulch treatment, no significant soil losses are expected.

Due to prolonged soil storage, the same biological impacts discussed previously would occur here. However, the size of each disturbance within the facilities area is quite small. Therefore, reinvasion of microorganisms and native plants should take place within a couple of growing seasons, and soil quality would improve progressively.

VEGETATION

Summary. Mining would destroy 67 acres of native vegetation and 26 acres of previously disturbed land. The tailings dump, tailings sites from previous mining, and stored topsoil would be revegetated while the mine operates. With few exceptions, seeded grasses and forbs would establish an erosion-controlling ground cover. Douglas-fir would slowly invade the waste rock dumps, road and slurry line corridors, and edges of the tailings dumps. Planted Douglas-fir seedlings would also grow on the waste rock dumps. Several decades would be required for newly established Douglas-fir to reach premining heights. Problems that may be encountered during revegetation include introduction of weeds, occasional erosion on steep slopes, and damage to developing plants by wildlife and blowing tailings.

Mining, as proposed, would destroy 67 acres of native vegetation within the permit area comprised primarily of the big sagebrush/Idaho fescue and Douglas-fir types (table II-10). In addition, 26 acres of previously disturbed land would be removed.

Most of the affected land would be revegetated while the mine is operating. The 53-acre tailings dump would be revegetated in increments of 4.6 to 9.2 acres. The waste dump, soil stockpile sites, facility sites, and other disturbances would be revegetated within two years after the mine closes. At some point during mining, tailings that existed before the applicant's operations would be removed and the sites reclaimed.

The applicant hopes to provide a postmining environment that would provide wildlife habitat and livestock grazing land. It proposes to reestablish 80 acres of grassland and 13 acres of Douglas-fir forest to reach these objectives. All revegetated areas would be examined after planting. If revegetation failures are noted, the applicant would consult with DSL to develop solutions. Any modifications in the reclamation plan would require DSL's approval.

General Procedures for Revegetation

Revegetation would start with the ripping of highly compacted surfaces to improve moisture infiltration and root penetration. The tailings would then be covered with 24 inches of topsoil. Other areas would receive roughly six inches of topsoil. Topsoil quantity and quality are expected to be sufficient for plant establishment and growth (see Chapter III--Soils).

During spring or fall, fertilizer containing phosphorus and potassium would be disked into the soil. After subsequent seeding, two tons per acre of straw mulch would be anchored into the soil. Unless the applicant uses a "clean" mulch, introduced weeds may become established and compete with the desired species for nutrients and water (Kay, 1980). Nitrogen fertilizer would not be applied until the following growing season. Application rates for fertilizer would be based on site-specific soil tests.

Revegetation procedures for slopes over 33 percent would differ from those described above. A mixture of water and seed would be sprayed (hydroseeded) over these steep slopes. The mixture would also contain fertilizer. Hydromulch (wood fiber and water) would then be applied at a rate of one ton per acre. Small patches of soil on these areas would probably be eroded. Hydromulch does not offer complete protection from erosion (Kay, 1980).

Small portions of the waste rock dumps would not be seeded. These areas would be planted with Douglas-fir seedlings.

Livestock grazing would be prohibited within the permit area for two years after revegetation. This period of protection would be sufficient to prevent damage to grasses and forbs (Laycock, 1982). A few developing woody plants, however, could be lost to browsing livestock.

The large numbers of deer and elk (see Chapter II--Wildlife) would cause more damage to revegetated areas than would livestock. Rodents would probably be attracted by the straw mulch (Stoeckler and Slaubaugh, 1965) and may consume seeds and harm seedlings. The magnitude of problems caused by wildlife cannot be predicted. The applicant would attempt to control damage by using chemical repellents, selective fencing, or terminal bud protective coverings. These protective measures are at least partially effective in reducing wildlife damage (Lyon and Ward, 1982).

Blowing tailings may damage some of the vegetation planted on the tailings dump. Most damage would occur during the summer. If problems from wind-blown tailings were excessive, DSL would require the applicant to take corrective action, such as using a chemical binder on the tailings.

Seeding-Herbaceous Species

The applicant proposes to use two seed mixtures for final revegetation (table III-8). The waste rock dumps, and portions of the roads and slurry line corridors (totalling about 13 acres) would be drill seeded with 28.5 pounds per acre of mixture number 2. The remaining 80 acres of disturbance would be broadcast or drill seeded with mixture number 1. This mixture would also be used in reclaiming the tailings sites that were created by previous mining. (All slopes over 33 percent would be hydroseeded.) Stockpiled topsoil would be stabilized with hydromulch and grasses and clover (table III-9). After topsoil is distributed, the stockpile sites would be seeded with seed mixture number 1.

Species selected for revegetation are generally well adapted to the Jardine area and seeding rates fall within the range recommended by Brown et al. (1976). Development of an erosion-controlling ground cover is therefore expected.

Table III-8: Proposed Seeding Mixtures for Revegetation

Common Name[1]	Seed Mixture No. 1				Seed Mixture No. 2	
	Rate PLS:[2] broadcast	Rate PLS:[2] drill	Percent of mixture: broadcast	Percent of mixture: drill	Rate PLS:[2] broadcast	Percent of mixture: drill
Meadow foxtail[3]	1.0	0.5	5.5	5.1	1.0	5.8
Beardless wheatgrass	4.0	3.0	6.8	9.4	4.0	7.2
Western wheatgrass	4.0	3.0	6.2	8.6	0.0	0.0
Slender wheatgrass[4]	4.0	2.0	8.6	8.0	4.0	9.2
Mountain brome[5]	10.0	5.0	9.8	9.1	10.0	10.4
Hard or Idaho fescue	2.0	1.0	16.0	14.9	2.0	17.1
Big bluegrass	1.0	0.5	11.9	11.2	1.0	12.8
Canada bluegrass	0.5	0.25	16.8	15.7	0.5	18.0
Green needlegrass	4.0	2.0	8.9	8.6	0.0	0.0
Indian ricegrass	0.0	0.0	0.0	0.0	4.0	9.2
Arrowleaf balsamroot	1.0	1.0	0.4	0.7	1.0	0.4
Alsike clover	1.0	0.5	9.2	8.7	1.0	9.9
Additional forbs	Trace	Trace	Trace	Trace	Trace	Trace
TOTAL	32.5	18.75	100.0	100.0	28.5	100.0

Source: Project application, 1984.

[1] See appendix 5 for scientific names.

[2] Lbs/acre of pure live seed.

[3] Pinegrass may be substituted in mixture 2.

[4] Elk sedge may be substituted in mixture 2.

[5] Indian ricegrass would be used on some sites.

Table III-9: Soil Stockpile Seed Mixture

Common Name	Rate PLS[2] hydroseed	Percent of mixture
Slender wheatgrass	8	16.9
Canada bluegrass	1	33.3
Hard fescue	3	31.5
Alsike clover	2	18.3
TOTAL	14	100.0

Source: Project application, 1984.

[1] See appendix 5 for scientific names.

[2] Pounds/acre of pure live seed.

Revegetation would increase production of wildlife and livestock forage in the disturbance areas. This increase would be due primarily to the revegetation of land disturbed before the applicant's operation. Other factors increasing plant productivity include fertilization, increased nutrient availability after soil disturbance, and reduced plant competition. The initial decrease in density of shrubs would increase livestock forage while somewhat reducing wildlife browse. Although long-term productivity would decline, it would remain above premining levels.

Revegetated areas would have lower plant diversity than premining forests and shrubby areas. Diversity, however, would slowly increase as plants invade from nearby, undisturbed areas. In addition, revegetation would improve plant diversity of previously disturbed lands.

Woody Species

The applicant's reforestation plan is primarily based on natural regeneration. Reestablishment of the Douglas-fir forest is expected on waste rock dumps and roads. Each of these disturbances is small and surrounded by undisturbed Douglas-fir forests. Seeds from existing trees would fall into the topsoil and, eventually, seedlings would develop. Douglas-fir is characterized by abundant seed production, effective seed dissemination, and prolific natural regeneration (Ryker and Losensky, 1983; Seidel, 1975).

Natural regeneration would be supplemented by planting Douglas-fir seedlings on the gentler uphill halves of the waste rock dumps. Each of the five waste rock dumps would be planted with about 430 containerized seedlings or about 860 bare-root seedlings (555 containerized or 1,110 bare-root seedlings/acre). The tree-planting sites would not be seeded with herbaceous species. This would reduce the competition that has been shown to limit seedling establishment (Larson and Schubert, 1969; Stewart and Beebe, 1974; Kittams and Ryker, 1975). Still, total survival cannot be expected. Mortality rates could range from 13 percent to 58 percent (Hite, 1974; Kittams and Ryker, 1975; Noble et al., 1978; Stein, 1984). Even with the highest mortality rate, premining Douglas-fir density (table II-12) would be exceeded. Roughly 40 to 100 years would pass before tree heights reached average heights that existed in premining forests.

Shrub seedlings would be planted at random locations throughout each waste rock dump. Thirty containerized or 60 bare-root seedlings would be used. The total number of seedlings would be equally divided among serviceberry, gooseberry, and snowberry. Survival would vary by species, with snowberry possibly having the highest survival (Fedkenheuer et al., 1980; Howard et al., 1979). Developing herbaceous plants from seed mixture number 2 would compete with shrub seedlings for water and nutrients. This would increase shrub mortality (Penrose and Hansen, 1981; Ferguson and Frischknecht, 1981; Van Epps and McKell, 1983). Over the long term, shrubs from surrounding undisturbed land would invade the waste rock dumps. Also, surviving planted shrubs would spread by root sprouting or seed dissemination. Sagebrush, followed by Douglas-fir, would eventually begin to invade portions of the reclaimed tailings dump.

Mitigating Measures

--Fall planting would give seeds a winter to meet the cold-induced dormancy requirements for germination required by some species (Brown and Johnston, 1978). Moreover, fall-planted seeds are in place to use favorable early spring moisture for germination. Moisture is available before seeding sites are accessible in spring due to snow and wet soils (Laycock, 1982; Brown et al., 1976). If the project is seeded during the spring, the advantages of fall seeding would be lost.

--Using the cleanest straw mulch available would reduce the chances of weed introduction. A mulch of native range hay would probably contain few weed seeds and would be an alternative to straw mulch.

--Scalping (removing grasses and weeds) or applying a short-term herbicide around individual seedlings would increase the survival of planted shrubs.

WILDLIFE

Summary. Along with previously developed land, mining would remove 67 acres of wildlife habitat. Displaced wildlife would find habitat nearby and reclaimed land would eventually provide suitable habitat. Elk and deer would initially avoid mining activity, but may, after habituation, move to habitats near the permit area. Significant disruptions of elk migrations are not expected. Mine-related traffic may increase road kills and conflict with other vehicles during the late-season elk hunt. Increases in poaching and antler-collecting, combined with existing levels of these activities, would be detrimental to wintering big game animals. Proposed logging would only slightly increase negative impacts on elk.

Mining, in general, can have both direct and indirect impacts on wildlife. Direct impacts include habitat loss and subsequent displacement of animals, establishment of new habitats by reclamation, destruction of relatively nonmobile wildlife, and disturbances to nearby animals by mining activities. Indirect impacts include collisions between vehicles and wildlife (road kills) and demands on the environment (such as housing requirements, recreation, and poaching) that would rise as the human population increases.

Many of the elk and mule deer wintering in the Jardine area spend other seasons in Yellowstone National Park. Other individuals move to higher elevations north of the park. Any significant population changes occurring in the Jardine area would be noticed at distant points. The quantity and quality of winter ranges often limits big game population size (Mautz, 1978; Lyon and Ward, 1982). Animals may respond to nearby disturbances, increasing their energy use. If they use more energy than their bodies have stored for the winter, or more than is supplied by forage, their health will be affected. Energy otherwise available for reproduction will be depleted. Other problems associated with excessive disturbance include increased adrenocorticoid levels in the blood, reduced birth weights, and absorption or abortion of embryos (Geist, 1971). These responses would be damaging to the populations. However, few studies definitely link disturbances to changes in reproduction or other population parameters (Ferguson and Keith, 1982).

Direct Impacts

Wildlife Habitats. Mining would remove 93 acres of wildlife habitats. However, 28 percent of the disturbance area consists of previously developed lands. The loss of these lands would not have significant impacts on wildlife. Big game were not sighted in developed lands (Chapter II--Wildlife) and use by other species is probably light.

Mining would destroy 39 acres of the big sage/grass habitat, 19 acres of the Douglas-fir/big sage habitat, and 9 acres of the Douglas-fir/common snowberry habitat. The big sage/grass type is particularly important to wintering deer and elk. In fact, all three habitats are used by various wildlife species. However, amounts disturbed by mining represent only a small portion of available habitats (table II-10). Overall impacts of habitat loss on wildlife populations would be minor. Displaced animals could move into nearby and abundant habitats.

Much of the disturbance area could not be used by wildlife until reclamation is complete--at least 22 years after mining is initiated. However, the 53-acre tailings dump and some other sites would be revegetated during mining. Revegetation would establish a ground cover of herbaceous species (see Chapter III--Vegetation). These species, combined with invading woody plants, would eventually supply adequate forage for most animals. Cover availability, however, would be low until woody species mature. The revegetation of previously developed lands (existing tailings, building sites, etc.) would benefit wildlife.

Elk. The proposed tailings dump would be located within elk winter range (figure II-12). Most other mine facilities would lie just north of this range. The area covered by the tailings dump represents less than one percent of the 34 square miles of elk range. Although relatively small, the 60 acres of habitat removed by the tailings facilities are important to elk. Elk could compensate for lost habitat by using the nearby Douglas-fir and big sage habitats that would remain undisturbed. Revegetation of the tailings dump would eventually supply suitable elk habitat.

The potential for elk to be poisoned if they ingest tailings from the working face of the dump is a concern. The factors that would determine the likelihood of poisoning, however, are unknown. (These factors include metal toxicities, attractiveness of salts in the tailings, quantities of materials that may be consumed, and frequency of consumption.) In addition, elk would initially avoid the tailings area during mining due to human activities and noise (see below).

The applicant would address the potential for poisoning by monitoring elk use of the tailings area. The monitoring proposal would be subject to approval by the permitting agencies. The agencies would periodically evaluate observation data. If elk were observed in the area consistently or were sighted consuming tailings, the agencies would require an exclosure fence around exposed tailings. The fence would also be required if offsite mortality could be conclusively attributed to tailings ingestion. Completed reclamation of the tailings would eliminate concerns about poisoning.

Water in the seepage collection and return ponds would also contain potentially toxic material. The proposed 7-foot-tall, woven-wire fence would prevent elk from reaching the seepage collection pond. However, elk that become accustomed to mining activity could drink from the return water pond.

Elk would respond to mining and associated activities by moving away from the project area. Elk initially avoid areas with substantial human influence (Knight, 1980; Ward, 1976; Irwin and Peek, 1983; Ferguson and Keith, 1979). The precise distance of the elk withdrawal cannot be predicted. However, studies by Ward (1976, 1985) suggest that elk prefer to be at least 1/2 mile from people on foot. For the proposed mine, 1/2 mile is a reasonable estimate. The figure lies within a range of withdrawal distances given by other studies (table III-10). It must be noted, however, that ungulates inhabiting national parks often exhibit less pronounced responses to human activity (Geist, 1971). In addition, construction levels would be low during the winter months. The applicant's commitment to salvage soil during periods of good tilth would greatly reduce wintertime construction. Regardless of the distance, areas with visual barriers separating the mining activities and elk would probably receive the most use (Montana Cooperative Elk-Logging Study, 1976; Olson, 1983; Ward, 1985). Either topography or timber would serve as a suitable barrier (Lyon, 1975).

Noise from the mill would not be loud enough to disturb elk. Sound levels must be at least 54 dB(A) to elicit a response from elk (Ward et al., 1976; Ward, 1985). This sound level would exist only within 640 feet (0.12 mile) of the mill (Chapter III--Aesthetics, table III-27).

Table III-10: Influence of Human Activities and Roads on Elk

Human influence	Upper limit of influence	Elk response within upper limit	References
Moving automobile	0.1 mile	Increased heart rate	Ward and Cupal, 1979
Stopped automobile	0.3 mile	Increased heart rate	Ward and Cupal, 1979
People on foot	0.2 mile	Increased heart rate	Ward and Cupal, 1979
People on foot	0.5 mile	Avoidance of people	Ward, 1976, 1985; Ward et al. 1976
Seismic exploration	0.6 mile	Increased daily movements	Knight, 1980
Roads	0.125 mile	Avoidance of roads	Rost and Bailey, 1979
Roads	0.25 mile	Avoidance or roads	Hershey and Leege, 1976; Irwin and Peek, 1983
Roads	0.5 mile	Avoidance of roads	Perry and Overly, 1976, 1977
Roads	1.2 mile	Avoidance of roads	Morgantini and Hudson, 1979
Logging	4.0 mile	Displacement	Montana Elk-Logging Study, 1976

Elk have already been forced to adjust to the county road. Increased traffic on this road (see Chapter III--Transportation) would probably not cause further adjustments. Schultz and Bailey (1978) found that traffic volume did not significantly affect elk.

Mining and traffic on the county road are not expected to significantly disrupt traditional elk migrations. Existing roads and traffic apparently have no effect on elk migrations (USDA Forest Service, 1982). Ward et al. (1976) indicate that only highways act as barriers to elk movements. However, elk may abandon some specific migration routes to avoid the project area and those road segments with traffic concentrations. Cut-and-fill slopes and debris created during road improvement could block some routes. Elk would probably select nearby alternative routes. Adams (1982) noted the use of alternative routes when traditional routes became unavailable. Alternative routes across the road would probably be located on saddles or gentle slopes or in heavy cover (Lyon, 1975; Ward, 1976).

Activities in the permit area and along the county road have the potential to affect elk behavior. Behavioral responses to human activity has been reported in other instances. Elk became more nocturnal and increased use of habitats with heavy cover to avoid humans (Geist, 1971; Schultz and Bailey, 1978; Morgantini and Hudson, 1979). The change in habitat use could lead to changes in food habits. Morgantini and Hudson (1985) found that grass consumption declined while browse consumption increased. The resulting decline in digestible energy could negatively affect elk populations during severe winters (Morgantini and Hudson, 1985). Westech (1984, p. 214) suggests that late-season hunting led to smaller group sizes. Cameron et al. (1979) noted a similar decline in group sizes of caribou during construction of the Alaska pipeline. Geist (1982) explains how reduced group size could adversely affect foraging efficiency.

Eventually, elk would become accustomed to activity due to mining. Their behavioral responses would become less pronounced and they may begin using habitats closer to mining activities. Elk habituation to human presence has been reported by Ward et al. (1976), Schultz and Bailey (1978), Knight (1980), and Ferguson and Keith (1982). However, habituation would depend on non-threatening behavior in humans (Geist, 1971). Thus, non-mining activities, such as hunting, would complicate the habituation process.

When the mine closes, elk could return to reclaimed areas and traditional migration routes. After disturbances of elk habitat or migration routes stop, elk have been found to return (Montana Cooperative Elk-Logging Study, 1976; Ward, 1976, 1985; Knight, 1980; Adams, 1982).

Elk displaced by mining activity or habitat loss would move into adjacent habitats. They would compete for resources with the elk already in those habitats and with other wildlife. The magnitude of the competition and resulting population effects cannot be predicted.

Mule Deer. The tailings dump would cover a very small portion (less than one percent) of deer winter range (figure II-12). Other facilities would lie just north of this range. Mining would increase traffic on the county road that runs through the winter range.

The loss of such a small portion of winter range would not significantly affect mule deer. Although the deer would lose important big sage and Douglas-fir habitats, these habitats are abundant in the surrounding area and would be used by displaced deer. Revegetation of the tailings dump would eventually provide usable habitat. However, decades would pass before adequate woody cover and browse species are available (see Chapter III--Vegetation).

The presence of a tailings dump and associated ponds in mule deer range would create the same concern that was mentioned previously for elk. The same unknown factors would also be present (see Elk subsection). The monitoring and contingency plans previously described for elk would detect and correct potential problems. Fencing would prevent deer from reaching the seepage collection pond. The return water pond, however, would be accessible.

The noise and activity of mining may displace some nearby deer. Deer, as noted above, are expected to react less strongly than elk; their security requirements are significantly less than those of elk (Lyon and Jensen, 1980). Studies on deer response to roads (Rost and Bailey, 1974; Perry and Overly, 1977) suggest that deer use would decrease in all areas within 1/8 mile of mining. Competition between displaced mule deer and offsite wildlife would not be great enough to cause noticeable population changes.

Mule deer have already adjusted their habitat-use patterns to the county road. Increases in traffic probably would not further influence habitat use. Carbaugh et al. (1975) found that observations of white-tailed deer, generally more sensitive to human presence than mule deer, were not correlated with traffic volume.

Other Big Game Species. Black bears are considered common in the Jardine area (Westech, 1984) and probably range across the permit area. Bears would therefore lose a small amount of habitat to mining disturbance. Some bears may leave the area. The tailings dumps would approach a den along Bear Creek. Construction and reclamation of the dump could render this den unusable. However, the importance of this den has not been assessed. Garbage on the permit area would be stored in bear-proof containers and would not be allowed to accumulate. This would reduce the chances for bear/human confrontations.

Another wide-ranging predator, the mountain lion, would also lose a small amount of noncritical hunting habitat. After replanted vegetation matures, well after the mine closes, adequate bear and lion habitat would again be available in the disturbance area.

The direct impacts of mining on moose would not be significant. Moose were infrequently observed along lower Bear Creek near the permit area. However, only a small amount of forested habitat types, important to moose, would be removed. The mine would not directly affect bison or bighorn sheep.

Small- and Medium-Sized Mammals. Small mammal populations would be displaced or eliminated by mining. The straw mulch used during revegetation would initially attract small mammals to reclaimed areas (Stoeckeler and Slaubaugh, 1965). Revegetated lands supply suitable habitat (McCann, 1975; Hingten and Clark, 1984) and repopulation is expected. Medium-sized mammals, such as coyotes and porcupines, would be displaced from the disturbance area. Overall population impacts would be unnoticeable and reclaimed areas would eventually provide suitable habitat.

Birds and Reptiles. Mining may cause a red-tailed hawk pair to desert a nest along Bear Creek. Red-tails, especially early in their reproductive cycle, may not tolerate disturbances near their nests (Jackman and Scott, 1975). However, potential nest desertion may not be significant--use of the nest has not been established. The baseline report does not give specific locations for other raptor nests. It is possible that mining could remove an occasional tree nest. Hunting habitat for raptors would be slightly reduced while the mine operates. The applicant would request that Montana Power Company design power lines according to Olendorff et al. (1981) (Jerry Danni, Homestake Mining Company, pers. comm., June 5, 1985). Adhering to these criteria would avoid raptor electrocutions.

Songbirds would leave the disturbance area until revegetation has created sufficient cover. The invasion of sagebrush and Douglas-fir to supply the cover would take decades. Water in the seepage collection and return ponds could attract some waterfowl. These birds could be contaminated by materials in the water. However, any birds entering the ponds would be detected by the applicant's monitoring. The applicant and the permitting agencies could then develop responses.

Mining would have minimal effects on grouse. Only a few rattlesnakes or racers would be killed or displaced.

Indirect Impacts

Road Kills. Traffic increases on the county road and on U.S. 89 (see Chapter III--Transportation) would increase road kills of wildlife. The proposed bussing and carpooling (see Chapter I) would limit the traffic increase. Low speed limits would further moderate the number of road kills. Speed limits are higher along U.S. 89. However, traffic would not increase as much as on the county road. This would limit the increase in road kills along U.S. 89. Like the county road, U.S. 89 runs through deer and elk winter range. Deer and elk would account for most of the increase in road kills. However, all wildlife species would be exposed to a greater chance of being struck by vehicles. The U.S. Forest Service and Montana Department of Highways have policies designed to reduce carrion along roadways. These agencies are assisted by the Montana Department of Fish, Wildlife and Parks. Removing carrion would reduce the potential for animals scavenging along roads to be struck by vehicles. Although the increase in road kills may be noticeable, significant effects on wildlife populations are not expected.

Housing Construction. Only a small amount of wildlife habitat in Park County would be lost to housing development. The locations of the 7.5 to 19 acres of new homesites cannot be predicted (see Chapter III--Land Use). Land ownership patterns, however, would allow development only on the edges of the Jardine study area's deer and elk winter ranges. Houses built in Livingston or below Emigrant would not affect wildlife that inhabit the Jardine study area.

Hunting. Even without the mine, hunting demand is expected to increase in the Gallatin National Forest (see Chapter III--Recreation). Mine-related population growth would add only a small amount to projected increases in hunting demand in the Jardine area. Most hunter use near Jardine comes during the late-season elk hunt. Actual hunting levels during this special season would be regulated by the Montana Department of Fish, Wildlife and Parks. This agency would also continue to regulate the hunting of other wildlife species.

Disturbance to wildlife during the late-season elk hunt would occur primarily within 1.5 miles of the county road. Westech (1984) observed most hunters within this distance of the road. All winter ranges east of Bear Creek have been closed to late-season hunting. The proposed mine is east of the hunting area and would not interfere with hunters. Mining-related traffic would add to the high level of hunting vehicles on the road. Even with the applicant's traffic reduction plan, the total traffic may rise above desired levels.

Other Recreation. Mine-related population increases would lead to more recreation in the Jardine area. However, most of the increase would occur even without the mine (see Chapter II--Recreation).

The most prevalent form of recreation after hunting in the Jardine area is antler collecting (see Chapter II--Recreation). (Although antler collecting is classified as recreation, some individuals apparently derive considerable profit from the activity.) Antler collectors probably spend much of their time on foot. The elk would respond to the collectors with increased heart rates or modified behavior (Ward et al., 1976; Schultz and Bailey, 1978; Ward and Cupal, 1979). Mule deer and bighorn may also respond with energy-consuming behavior.

The collectors are usually active in late winter or spring, when animals may be in weakened condition. Although increases in antler collecting due to mine-related population growth would be small, deer, elk, and bighorn populations may still be negatively affected. The level of stress currently created by antler collecting may already be overstressing big game. (Tom Puchlerz, U.S. Forest Service and Jon Swenson, Montana Department of Fish, Wildlife and Parks, pers. comm., March 7, 1985). Westech personnel (1984) observed occasional harassment of the elk by antler collectors.

The mine-related population growth would slightly add to projected increases in camping (see Chapter III--Recreation). If past use patterns are followed, camping would be concentrated at the Eagle Creek campground (Westech, 1984). Disturbance effects on wildlife would, therefore, be highly localized. Other categories of recreationists spend little time in the Jardine area (Westech, 1984).

Poaching. Some of the 112 to 262 people added to the population by the mine would possibly engage in poaching (see Chapter III--Sociology). Klein (1979) noted that construction of the Alaska pipeline brought an increase in poaching. Illegal killing is currently a noticeable mortality factor of deer and elk. All wildlife species would be exposed to poaching, although big game species would be most affected. Some poachers would be tempted to enter Yellowstone National Park where poaching is already a problem (National Park Service, 1982). Poaching by mine employees would be minimized by the applicant's policy of dismissing employees who violate fish and game laws (R.T. Agar, ACNC, pers. comm., January 22, 1986). The applicant would post state and federal hunting, fishing, trapping, and recreation regulations in conspicuous locations at the Jardine mine. Furthermore, firearms would not be allowed in company vehicles, and unauthorized personnel would not be allowed to carry firearms (project application, 1984).

Cumulative Impacts

This section describes the cumulative impacts on elk and deer, the species of most concern. Cumulative impacts are the incremental impacts of the proposed action when added to past, present, and reasonably foreseeable future activities. Other activities could amplify the negative effects of mining. Some of the activities include developed and dispersed recreation, antler collecting, game hunting, timber sales, and activities along trails and roads (see table II-46). The analysis of cumulative impacts considers activities within the year-round ranges of elk and deer that use the Jardine area (cumulative effects analysis area).

Small timber sales and the West Gardiner Access Plan were identified as activities that, when combined with the mine proposal and other present and past activities in the analysis area, would create cumulative impacts to elk and deer.

Logging would affect 25 acres/year from 1987 through 1996. Some of the logging could occur within or adjacent to the 1981-82 elk winter range (figure II-11). Roughly 1/2 mile of permanent roads and up to 1 mile of temporary roads may be constructed in winter range. By itself, logging would not significantly affect elk. Winter range loss would be minimal and displacement would not be great enough to cause population effects. However, simultaneous mining and logging would tend to increase pressures on the elk population. This pressure would be the result of habitat loss, displacement, and behavioral changes (see Chapter III--Wildlife--Direct Impacts).

Natural processes and management by the Forest Service would combine to reduce the impacts of logging on elk. Eventually, elk would habituate to human activities and native vegetation would invade logged sites. The Forest Service has committed to using management recommendations set forth in the Coordinating Elk and Timber Management handbook (Montana Cooperative Elk-Logging Study Committee, 1985). Furthermore, the Forest Service would close roads after logging and prohibit logging in adjacent drainages. In the Parker Point area, logging would be prohibited during the calving season. The Forest Service may also locate individual cutting units away from calving grounds. All these practices would greatly reduce or, in some cases, nearly eliminate logging impacts on elk.

Because logging would employ only a small work force (see Chapter III--Employment), indirect impacts of logging such as road kills, housing construction, hunting, and other recreation would be insignificant; therefore, cumulative indirect impacts would be similar to mining by itself (see Chapter III--Wildlife--Indirect Impacts).

The timber sales would not significantly increase impacts to mule deer above those created by mining. Deer winter range presently falls outside of the sections that may be logged. Logging would, however, remove some habitats that are lightly used in seasons other than winter. Some of the management for elk, such as post-logging road closures, would also reduce impacts to deer. In addition, naturally revegetated logging sites could provide more deer foraging areas.

The West Gardiner access plan includes the option of opening up existing roads along Mill Creek and Mol Herron Creek. These roads are within the summer range of mule deer that may spend other seasons near Jardine. Elk that use the Jardine area do not use the area covered by the access plan (see figure II-11). Improved access would allow for more mule deer hunting; however, hunting would not cause a noticeable change in the deer population. Although opportunities for poaching and harassment would increase, the actual levels of these activities would not be high enough to affect deer. No deer habitat would be removed and displacement is not anticipated.

Mitigating Measures

- --A 7- to 7-1/2-foot-tall, woven-wire fence constructed around the return water pond would deter wildlife from reaching the pond.
- --The Montana Department of Highways, Montana Department of Fish, Wildlife and Parks, and U.S. Forest Service would note road kills. If problem

areas were identified, the agencies could develop methods to reduce road kills. Methods may include lowered speed limits, game crossing signs, and fencing. Implementing these methods along the Jardine Road would require the Park County commissioners' approval.

--Prohibiting people from entering big-game ranges from December 15 through May 15 would reduce harmful stress on mule deer, elk, and bighorn sheep.

THREATENED AND ENDANGERED SPECIES

Summary. Mining would remove 67 acres of spring habitat used by foraging grizzly bears. The grizzlies would respond to habitat loss by moving into nearby, suitable habitats. After mine closure, revegetated lands would supply adequate foraging areas. Human activity would initially displace grizzlies from the vicinity of the permit area; however, some grizzlies would become accustomed to human activity and may forage near the mine, increasing the chances for encounters between grizzlies and humans. Human/grizzly conflict could lead to management actions that may include relocation or destruction of some grizzlies. The number of conflicts and outcomes of management actions cannot be predicted.

Increased recreation, mostly caused by population growth unrelated to mining, would increase human/grizzly conflicts. Opportunities to poach grizzlies and bald eagles would increase as the human population rises.

Logging could increase cumulative impacts on grizzlies; however, Gallatin National Forest would manage logging to minimize the increase.

Like impacts to other species, impacts to threatened and endangered species can be classified as direct or indirect (see Chapter III--Wildlife). Direct impacts include habitat change, animal displacement, conflicts with humans at the minesite, and destruction of species and wildlife. Indirect impacts include collisions between vehicles and animals (road kills) and increased use of the environment (such as recreation and poaching) arising from increased human population.

Direct Impacts

Grizzly Bear. Mining would remove 39 acres of big sage/grasslands and 28 acres of Douglas-fir forests. Grizzly bears use these habitats in the spring as they search for carrion and succulent plants. The loss of this 67 acres of spring habitat would have minor impacts on grizzlies. The disturbed acreage constitutes less than 1 percent of the big sage/grasslands and Douglas-fir forests available in the assessment area. Grizzlies could find adequate spring foods in nearby, undisturbed lands. After the mine closes, bears could forage in the revegetated lands.

The potential for grizzly bears to be poisoned if they consumed tailings from the active face of the dump is of concern. Factors that would determine the likelihood of poisoning, however, are not known (these would include metal toxicities, attractive qualities of salts in the tailings, relationship between grizzlies and salt, and the amount and frequency of consumption.) The probability of poisoning would be eliminated for those grizzlies that avoid the permit area (see below). The applicant's monitoring and contingency plans (see Chapter II--Wildlife, Elk) adequately address the concern. These plans would also prevent grizzly prey from being poisoned. The concern regarding grizzly poisoning would be eliminated with final reclamation of the dump.

Grizzly bears that habituate to mining activity could drink potentially harmful water contained in the return water pond. A 7-foot-tall, woven-wire fence would surround the seepage collection pond. It is doubtful that grizzlies would be sufficiently motivated to attempt to reach the pond.

Mining activity in the permit area is expected to displace grizzly bears initially. Grizzlies would retreat to those habitats where they could neither see nor hear the activities. A reasonable estimate of their withdrawal distance is one-half mile. Displaced grizzlies could encounter aggression from grizzlies residing in surrounding areas. Displaced and resident bears could also compete for resources. Although small population changes are possible, information to support specific predictions is not available. Eventually, some grizzlies would become accustomed to mining activities. These habituated bears may investigate the permit area for foods that people bring in, especially when natural foods are scarce. Although the applicant would use bear-proof garbage containers, the potential for some grizzly bears to forage in the permit area remains high. Subsequent confrontations with humans would require government agencies (USDA Forest Service, U.S. Fish and Wildlife Service, and Montana Dept. of Fish, Wildlife, and Parks) to resolve the problem. The agencies would respond based on the specifics of each incident. In a worst-case scenario, the grizzly involved would be destroyed. Given the current unfavorable ratio between grizzly bear deaths and births in the Yellowstone area, even slight additions to total mortality are of concern.

Bald Eagle. Mining would have only minor direct impacts on bald eagles. Important bald eagle habitat along the Yellowstone River and Bear Creek would remain unaltered. The applicant would request that Montana Power Company design power lines using criteria in Olendorff et al. (1981), (Jerry Danni, Homestake Mining Company, pers. comm., July 16, 1985). Following these criteria would prevent bald eagle electrocution. The power line, however, would create a slight collision hazard. Eagles commonly feed on gut piles along the Jardine road (L. Lewis, U.S. Forest Service, pers. comm., February 18, 1986). Mining activity and traffic may discourage eagles from roosting in some trees. However, eagles would continue to find adequate roosting trees in undisturbed areas.

Peregrine Falcon and Gray Wolf. Mining would not directly affect the peregrine falcon. Peregrines are rarely recorded in the assessment area and the wetland habitats supplying potential hunting habitat would not be disturbed. Although a peregrine could nest in cliffs along Bear Creek, mining activity would not be close enough to the cliffs to create a potential for nest desertion. Power line design would prevent falcon electrocutions (see Bald Eagle subsection).

Mining would have no impact on gray wolves. Wolves have not been sighted in the assessment area and their presence in Yellowstone National Park is questionable.

Plant Species. Mining would not affect threatened and endangered plants. None of the federally listed species occur in the assessment area.

Indirect Impacts

Road Kills. Traffic increases on U.S. 89 and the county road (see Chapter III--Transportation) would increase chances of a grizzly bear or bald eagle being struck by a vehicle. However, because the applicant's proposal would limit the traffic increase (see Chapter I), the probability of collisions would remain low. The chances for collision would be greater along U.S. 89, where speed limits are much higher. Road-killed wildlife (see Chapter III--Wildlife) could attract scavenging grizzlies or eagles to the roads. The Yellowstone National Park Bear Monitoring Office (1985) has documented instances of grizzlies being struck by vehicles along U.S. Highways 191, 287, and 89. During the late 1970s, a female and her cub were killed on U.S. 191 while feeding on moose carrion. The U.S. Forest Service, Montana Department of Highways, and Montana Department of Fish, Wildlife and Parks currently cooperate in removing carrion from roads. Their continuing efforts would reduce roadway scavenging by grizzlies. Furthermore, Gallatin National Forest and the Department of Highways are negotiating a plan that specifies timely removal of carrion.

Recreation. Recreation in the assessment area would increase as the human population rises. Most of the projected increase in recreation would occur even without mining (see Chapter II--Recreation). If future trends in recreation follow past patterns, hunting, antler collecting, and camping will account for roughly 90 percent of all recreation in the assessment area (see Chapter II--Recreation).

Any conflicts between recreationists and grizzlies which result in the relocation or death of a grizzly would increase concern about the Yellowstone grizzlies' welfare.

None of the threatened and endangered species in the assessment area can be legally hunted. However, the projected increase in hunting of other species could affect grizzly bears or bald eagles. With more hunters afield, the chances for grizzly/human confrontation would increase. Grizzlies may also be attracted to improperly stored food and game meat in hunting camps. The potential for black-bear hunters to mistakenly shoot a grizzly also would exist. Hunting would benefit grizzlies and eagles by creating additional food in the form of gut piles and wounded animals.

Like hunting, antler collecting increases the chances of grizzly bear and human confrontation. Prime antler collecting areas overlap grizzly spring range. However, confrontations would be limited by the relatively small predicted increase in antler collecting. Camping would increase primarily at the Eagle Creek campground (see Chapter III--Recreation). The potential for grizzly/camper conflicts would differ little from that existing before mining.

Poaching. Some of the 112 to 262 people added to the population by mining (see Chapter III--Demography) may occasionally attempt to poach a grizzly bear or an eagle. Poaching increases as people use an area more; this relationship was noted during construction of the Alaska pipeline (Klein, 1979). Several grizzlies are killed illegally each year in the Yellowstone area (Yellowstone National Park, 1985; IBGST 1979-82). If poaching increases due to mine-related population growth, the Yellowstone grizzly population would be further kept from recovery. However, the applicant's policy to dismiss employees who violate wildlife laws would deter the mine workers from poaching (R.T. Agar, ACNC, pers. comm., January 22, 1986). In addition, government agencies would prosecute violators.

Grizzlies or bald eagles feeding on roadside carrion would be more visible and thus stand a greater chance of being poached. Interagency efforts to remove carrion would continue to limit the exposure of these two species to poaching.

Compliance with Endangered Species Act

The U.S. Forest Service's biological assessment (Appendix 26) determined that mining would not adversely affect the bald eagle, peregrine falcon, or gray wolf. The assessment, however, concluded that mining may adversely affect the grizzly bear. The U.S. Forest Service initiated formal consultation with the U.S. Fish and Wildlife Service regarding the grizzly bear. The biological opinion of the Fish and Wildlife Service (1986) arrived at the conclusion that the project with the required mitigations would not likely jeopardize the continued existence of the grizzly bear.

Cumulative Impacts

Cumulative impacts are the incremental impacts of the proposed action when added to past, present, and reasonably foreseeable future activities in the area. Other activities could amplify the negative effects of mining. Some of these activities include developed and dispersed recreation, antler collecting, game hunting, timber sales, and activities along trails and roads (see table II-46). The analysis of cumulative impacts on threatened and endangered species considers activities within the assessment area contained in the Hellroaring/Bear (Creek) Bear Management Unit (figure II-16). These impacts would combine with mining to increase pressures on threatened and endangered species in the analysis area. In the case of this study, the threatened grizzly bear would be the threatened or endangered species most affected by cumulative impacts in the assessment area.

The U.S. Forest Service proposes to conduct small timber sales in the assessment area. These sales, affecting 25 acres per year from 1987 through 1996, would combine with mining to increase impacts on grizzly bears. Although shorter in duration, direct impacts caused by these timber sales would be similar to mining impacts: grizzlies would experience habitat loss, displacement, increased chances for conflicts with humans, and increased possibilities of being poached.

Logging could eventually affect about 250 acres of grizzly habitat (25 acres per year). During and immediately after logging, this acreage would not be available to grizzlies. However, natural revegetation would replace affected habitats eventually. Logging would encourage the growth of forage plants, improving habitat in those areas where cover is not limiting. The timber sales could be designed so that quality cover habitat would be available to grizzlies.

Chances of poaching or grizzly/human conflicts because of logging would be fewer than the chances caused directly or indirectly by mining because of the small number of loggers (see Chapter III--Employment). Also, indirect impacts are not anticipated because logging would only slightly increase the human population.

Grizzlies may become accustomed to logging activity. This would benefit the grizzlies by allowing them to use habitats adjacent to logging sites; however, the negative effect in this case would be increased chances for confrontations between grizzly bears and people.

Changes in the Yellowstone area's grizzly population resulting from human/grizzly conflicts cannot be reliably predicted. Although chances for these conflicts would increase, there is no way to predict the frequency of encounters. The variation in bear management actions and in grizzly behavior further complicates prediction capabilities.

Management by the U.S. Forest Service could reduce or eliminate the impacts of logging on grizzlies, thereby reducing cumulative impacts. Current management follows Grizzly Bear Standards and Guidelines for Gallatin National Forest (USDA Forest Service, 1984). The Forest Service and other agencies have been determining the effectiveness of habitats in the Yellowstone area (USDA Forest Service, 1985). The more effective habitats meet the grizzlies' requirements for food, cover, and isolation from people. The Interagency Grizzly Bear Committee will specify a desired level of habitat effectiveness for the assessment area (Jerry Light, U.S. Forest Service, pers. comm., September 25, 1985). Forest Service land management will be designed to achieve this desired level. Another objective is to keep human-caused grizzly deaths at or below existing levels. Meeting these objectives could mean cancelling or modifying some land use activities.

Mitigating Measures

--A 7- to 7-1/2-foot-tall, woven-wire fence constructed around the return water pond would deter wildlife from reaching the pond.

--The U.S. Forest Service and the Montana Department of Highways would finalize a program designed to remove carrion from highways in grizzly bear range. This plan would be extended to cover U.S. 89 between Gardiner and Tom Miner Basin (western boundary of the federal Bear Management Unit).

--Attraction of grizzly bears to the permit area would be reduced if the applicant's food storage and garbage disposal plans follow criteria in Grizzly Bear Standards and Guidelines for Gallatin National Forest (USDA Forest Service, 1984).

- --If the applicant advises Jardine residents of proper garbage-disposal and food-storage practices, confrontations between humans and grizzlies could be reduced. In addition, this effort would be strengthened if the applicant provided residents with bear-proof garbage containers.
- --The Montana Department of Highways, Montana Department of Fish, Wildlife and Parks, and U.S. Forest Service would note road kills. If problem areas were identified, the agencies could develop methods to reduce road kills. Methods may include lowered speed limits, game crossing signs and fencing. Implementing these methods on the Jardine Road would require the cooperation and approval of the Park County Commissioners.

CLIMATE

The small amount of particulate matter emitted from ground-level sources during mining and milling would not affect the climate of the area.

AIR QUALITY

Summary: With proper control, the predicted dust emissions would not adversely affect the air quality near Jardine. The estimated total suspended particulate (TSP) concentrations occurring during the operation would probably be well below all applicable Montana Ambient Air Quality Standards (MAAQS).

Construction Emissions

During the construction period, dust emissions would total about 212 tons, or 170 tons per year. Nearly 80 percent of this dust would be generated by general construction activities--for example, heavy equipment moving over exposed areas. Topsoil removal, access road traffic, and road maintenance would generate about 32 tons of dust per year, or 18 percent of total (table III-11). The applicant would water all exposed areas and roads to minimize dust. According to the EPA (1976) this would require complete coverage twice a day. Disturbed areas and stockpiles would be revegetated as quickly as possible, also reducing wind-blown dust.

Milling Emissions

Only small amounts of particulate would be emitted from the milling process. The emissions would be vented to the outside through either a scrubber or baghouse, which would trap about 98 percent of the particulate. The particulate emissions from the crushing, screening, and conveying would total about 2 tons per year (table III-12).

Table III-11: Construction Phase Fugitive Emissions

Activity	Uncontrolled emissions tons/yr	Controls BACT[1]	Percent control	Controlled emissions tons/yr
Topsoil removal	12.6	Minimize fall distance	0	12.6
Topsoil loading	0.7	Minimize fall distance	0	0.7
Topsoil dumping	0.1	Minimize fall distance	0	0.1
Topsoil stockpile	0.9	Revegetation	75	0.4
Disturbed areas	6.0	Revegetation	75	3.0
Construction emission	267.0	Watering	50	133.5
Access roads	24.4	Watering	50	12.2
Road repairs	14.6	Watering	50	7.3
	326.3			168.6

Source: Jardine Joint Venture Air Quality Permit Application, 1985.

[1] Best available control technology.

Table III-12: Process Particulate Emissions

Activity	Uncontrolled emissions tons/yr	Controls BACT[1]	Percent control	Controlled emissions tons/yr
Crushing	91.9	Scrubber or baghouse	98	1.8
Screen, convey, and handle	13.1	Scrubber or baghouse	98	0.3
	105.0			2.1

Source: Jardine Joint Venture Air Quality Permit Application, 1985.

[1] Best available control technology.

Mining

Emissions from controlled sources would total about 45 tons per year. Access road traffic and road repair would account for 84 percent, or 37.7 tons per year, of the dust. The other activities would contribute little to the particulate emissions (table III-12).

Tailings Dump

It is not known how much particulate would be emitted from the tailings. Using the wind erosion equation of Woodruff and Siddoway (1965), dust from tailings was estimated at over 15 tons per acre per year (on-file report, DSL, 1985). With an active face of five acres, 75 tons of dust per year would blow from the tailings dump. Using a tailings emission equation developed for the U.S. Environmental Protection Agency (1976), 6.8 tons per acre per year, or 41 tons per year would blow from the area. The Air Quality Bureau of the Montana Department of Health and Environmental Sciences recommends that an emission factor of 0.6 tons per acre per year be used. Using this emission factor, tailings emissions would be 3 tons per year. Dust from the tailings is estimated to be between 3 and 75 tons per year, depending on the emission factor used for calculations.

Regardless of calculation factors, the estimated amount of emissions from the proposed tailings would be similar to the dust blowing from the 6.2 acres of existing tailings. The existing air quality data indicate that concentrations of TSP are low (see Chapter II--Air Quality). Even if the proposed tailings doubled the present dust emissions, air quality standards would probably not be exceeded, as discussed below.

Total Suspended Particulate (TSP) Concentrations

Annual average and maximum 24-hour TSP concentrations were modeled in the Jardine Joint Venture Air Quality Permit Application (April, 1985). The model predicted that the mine would increase the annual average TSP concentration outside the permit area by a maximum of 6.7 $\mu g/m^3$.

The maximum increase in 24-hour TSP concentrations outside the permit area predicted by the model would be about 35.4 $\mu g/m^3$, still well below the MAAQS of 200 $\mu g/m^3$.

Even if the dust emissions from the proposed tailings doubled the baseline TSP concentrations (52 $\mu g/m^3$), the resulting maximum 24-hour TSP concentration of 104 $\mu g/m^3$ and the resulting annual average TSP concentration of 40 $\mu g/m^3$ would still be well below MAAQS.

The modeling included receptors located about two miles south of the project area in Yellowstone National Park and others in the Absaroka-Beartooth Wilderness areas. The park is designated Class I under the Prevention of Significant Deterioration (PSD) regulations; the wilderness area is Class II, as is the project area. The maximum increase in annual TSP concentration predicted in the park is 2.6 $\mu g/m^3$. The maximum 24-hour increase predicted in 11.1 $\mu g/m^3$, while the second highest is 9.9 $\mu g/m^3$. These would be below the maximum allowable increases for a Class I area. The maximum allowable increases (increments) from the PSD regulations are not applicable here because this project is not considered a major stationary source. Reference to the increments is used for comparison purposes only. The maximum annual increase predicted in the wilderness area is 2.6 $\mu g/m^3$ and the maximum 24-hour increase predicted is 8.1 $\mu g/m^3$.

Lead concentrations would be small. Based on the ore analysis and TSP concentrations, annual lead concentrations in the air are estimated to be less than 0.001 μg/m³, well below the MAAQS of 1.5 μg/m³.

The gaseous pollutant emissions would be minor (table III-13). So, concentrations of these pollutants in the air would also be small.

Table III-13: Gaseous Pollutant Emissions

Source	Extent of activity	Particulate	Carbon monoxide	Sulfur oxides	Hydro-carbons	Nitrogen oxides
		Tons per year				
Ammonium nitrate fuel oil explosive	97.5 tons/year	--	3.3	0.1	--	0.8
Diesel exhaust	156,520 gallons/year	1.4	7.2	2.4	3.0	41.0
Access road traffic	290,500 vehicle miles/ year	0.2	11.8	--	1.0	1.4
TOTAL		1.6	22.3	2.5	4.0	43.2

Sources: Jardine Joint Venture Air Quality Permit Application, 1985; U.S. Environmental Protection Agency, 1975.

Mitigating Measures

- --A sprinkling system to wet the tailings when necessary would reduce wind-blown tailings, a potentially major dust source (table III-14). In addition, the amount of wind-blown tailings could be reduced by lowering the fall distance from the conveyor to the working face and placing a hood on the conveyor.
- --The access road from Gardiner to Jardine is predicted to be a major dust source. The air quality permit application states that this road would be treated with a dust suppressant. The applicant has committed to dust suppression through Gardiner and Jardine. This is a requirement of the air quality permit. The need for additional control would be evaluated by the Air Quality Bureau through on-site inspections.
- --An air quality monitoring network of high-volume air samplers situated upvalley and downvalley of the permit area would insure compliance with MAAQS. A description of the pollution control measures that are required and the rationale for these requirements are included in the air quality permit, available from the Air Quality Bureau.

Table III-14: Mining Fugitive Emissions (Excluding Tailings)

Activity	Uncontrolled emissions tons/yr	Controls BACT[1]	Percent control	Controlled emissions tons/yr
Topsoil stockpiles	0.9	Revegetation	75	0.2
Disturbed areas	7.5	Revegetation	75	1.9
Ore/waste dumping	0.2	Minimize fall distance	0	0.2
Coarse ore stockpile	1.9	Watering	50	1.0
Haul roads--waste	0.1	Chemical stabilization	85	0.0
Haul roads--ore	16.2	Chemical stabilization	85	2.4
Access roads	202.5	Chemical stabilization	85	30.4
Road grading	14.6	Watering	50	7.3
Vehicle exhaust	1.6	Operation	0	1.6
TOTAL	248.5			45.0

Source: Jardine Joint Venture Air Quality Permit Application, 1985.

[1] Best available control technology.

INCOME

Summary. Mine employment would add $3.4 million annually to Park County income once the mine is at full employment. Secondary job increases would add between $359,936 to $506,160 to total county income.

Direct Employment Income

Project construction employment income is estimated to be about $1.4 million. This income would be paid to construction crews the last three quarters of 1986 and first three quarters of 1987. The total amount paid to Park County residents would depend on the number of local persons hired and the skill level and wage rates of construction jobs held by local workers. Between 25 and 50 percent of construction income could be paid to nonlocal workers who would spend the majority of these wages outside Park County.

Mine operation employment income would add $3.5 million to annual income in Park County. The total level would fluctuate, depending on wage increases and the level of mine employment. Including the wages of the 10 employees currently working on the project, the total project payroll would be $3.7 million when the mine is operating at projected full employment. Total mine-related income would fluctuate over time depending on wage increases and employment levels; however, it would add between 1.4 and 4.3 percent to forecasted levels of baseline Park County income (Mountain International, Inc., 1984, vol. 2, p. 124).

Induced Employment Income

Mine employment and resulting increases in consumer spending in Park County would be expected to foster between 32 to 45 new service sector jobs (see Chapter III--Employment). Table III-15 shows the average wage for all Park County jobs and for selected business sectors. In 1982, the average wage paid in Park County was $13,704. Jobs in service sectors earned slightly less. Retail trade jobs were paid an average of $10,085 while jobs in the service sector were paid $11,248.

Table III-15: Average Wages Paid in Selected Sectors of Park County Businesses in 1982 (in 1982 dollars)

Sector	Wage
All jobs	$13,704
Retail trade	10,085
Services	11,248

Source: Bureau of Economic Analysis, 1984, tables 5 and 25.

In 1989, one year after the mine is projected to reach the full employment production level, induced-employment income would average $359,936 to $506,160 annually, less than 1 percent of projected total county income that year. Mine-induced employment would not grow beyond 45 service sector jobs (see Chapter III--Employment); therefore, mine-induced secondary income would not grow substantially, either.

Temporary or Permanent Closure

The mine could close temporarily during its operation; such closures would cause county income to drop. The amount of the decline would depend on the length of closure and availability of unemployment benefits. If the temporary closure lasted long enough and consumer spending fell due to the mine closure, other business sector income could decline. After the mine closes permanently, income would fall to a level where it would have been without the mine.

Cumulative Impacts

The two timber sales planned by the U.S. Forest Service in the Gardiner-Jardine area could provide 3 to 22 additional jobs for local residents from 1987 to 1996. Assuming an annual average wage of $18,000, logging jobs could add $54,000 to $396,000 to total county income. Such increases represent less than 1 percent of total forecasted income without the timber sales.

EMPLOYMENT

> Summary. At peak employment, the project would add 140 new jobs to the Park County economy. An additional 32 to 45 jobs would be created due to increased income and spending from new mining jobs.
>
> After permanent closure of the mine, employment would decline to what it would have been without the mine. Temporary closures of the mine may cause service sector businesses to lay off other employees, if the closure lasts long enough.
>
> In the cumulative scenario, logging may add 3 to 22 seasonal jobs from 1987 to 1996. Crew sizes will be small and the operations will be short-lived. Some of the jobs may be filled by Park County residents.

Jobs. At full operation, the project would employ 150 workers, 10 of whom are already employed at the project site. Seventy-five would work in the mine, 25 at the mill, 20 at the maintenance shops, and 30 would be management, clerical, and laboratory personnel. During the 18-month construction phase, up to 55 construction workers would be hired by the applicant (Mountain International, Inc., 1984, Impact Plan, pp. 37 and 69).

The applicant has committed to hiring and training as many local people as possible (Mountain International, Inc., 1984, Impact Plan, p. 15). The applicant would attempt to hire 80 percent of the work force (120 employees) from within Park County and from Mammoth, Wyoming. However, project impact analyses have been determined for two scenarios, varying from 80 percent local hire to 50 percent local hire (see also Sociology, Income, Transportation, and Community Services). In each of the scenarios, the balance of the work force is assumed to be nonlocal people who move into Park County.

The project would add between 182 to 195 new jobs to the Park County economy--150 mining jobs and 32 to 45 service-sector jobs. The range of service-sector jobs assumes that three to five mining jobs would provide enough additional consumer spending in Park County to foster one other additional job. Mining is considered a basic industry; that is, its products are purchased by people and firms outside the local economy. New jobs created due to growth in basic industry employment are called derivative or nonbasic jobs. Table III-16 shows the estimated number of jobs created by the project employment during its first five years.

Table III-16: Estimated Number of Jobs Created During First Five Project Years

Year	Number of operations jobs--JJV project	Derivative employment		Total	
		Low	High	Low	High
1986	10	0	0	10	10
1987	34	2	3	36	37
1989	138	7	10	145	148
1990	150	29	41	179	191
1991	150	32	45	182	195

Source: Mountain International, Inc., Impact Plan, 1984, p. 38. Department of State Lands, unpublished working papers, May 1985.

Only permanent operations jobs have been used to estimate derivative employment because the construction force is small and the construction period too short to foster long-term, nonbasic job creation (Mountain International, Inc., 1984, vol. II, p. 118). Creation of nonbasic jobs is lagged one year to reflect the time necessary to develop or expand services in response to increased spending due to new basic-industry jobs. Such a time lag may be too optimistic. In addition, each basic-industry job is assumed to have the same impact on derivative employment whether it is filled by a Park County resident or a person from outside the county. This rationale is based on several assumptions. It is assumed that local hire would add the same amount of new spending to the Park County economy as nonlocal hire, because the local person hired would be currently unemployed or would leave a job that would be filled by another county resident.

Over the life of the project, between 32 and 45 new jobs could be added to the Park County economy as a result of increased mining employment. The low prediction is consistent with estimated historic and projected ratios of basic to nonbasic employment in Park County (Mountain International, Inc., 1984, vol. 1, pp. 269 and 276). The high estimate is based on predictions of mining-induced employment impacts for other rural Montana counties (Department of State Lands, unpublished working papers, January 1985 [Stillwater County], January-February 1985, [Big Horn County]).

It is unlikely that project employment would foster more than 45 derivative jobs. Gardiner and Livingston are within the market area of two large trade centers--Bozeman and Billings. If Park County residents and businesses shop elsewhere, derivative jobs would be limited (Mountain International, Inc., 1984, vol. 1, p. 281).

Temporary or Permanent Closure

The project would have an estimated life of 20 years. During the 17th year, employment would be scaled back as mining ceased and final reclamation began. At the end of the 20th year, the mine would close.

After the mine closes, former project employees would either leave or remain in the county. Employees remaining would find other jobs, use available unemployment benefits, or retire. Those unable to find other employment may leave the county to find other jobs.

Total employment in Park County would gradually adjust to a level that would have occurred without the mine. Once the mine closes, total county income and personal spending would decline to what it would have been without the mine. Service industries would adjust to the reduced level of spending by scaling back employment and output. Total adjustment would take several years.

During its operation, the mine could experience temporary shutdowns or periods when employment may be cut back. Cyclical production slow downs are difficult to predict because such events are due to a combination of circumstances including fluctuations in metal prices, labor costs, production costs, profitability of the company, and effects of national and international political and economic events.

During temporary shutdowns or reductions in force, unemployed mine workers could wait for the mine to reopen or jobs to be reinstated. The length of time unemployed miners would be willing to wait for work to continue would be influenced by the availability and terms of unemployment or severance pay, availability of other job opportunities, and strength of ties to the community.

Temporary mine shutdowns or reductions in force would have repercussions for other Park County businesses. Service businesses may also lay off employees or curtail services if spending in the county declined due to a mine shutdown or reduction in force.

Extended Life of Mine

The Jardine Joint Venture project could operate for more than 20 years if additional ore reserves of sufficient grade were discovered. Mine employment would be extended and the effects of a permanent closure would be delayed.

Cumulative Impacts

The Forest Service has scheduled several small timber sales in the Gardiner area between 1987 and 1996. It is estimated that each sale would employ at least five people. Potential local employment for each harvest is expected to be small--between 3 and 7 jobs each sale (Steve Christianson, U.S. Forest Service, pers. comm., September 18, 1985).

SOCIOLOGY

Demography

The proposed project is expected to employ about 50 workers during the initial construction period and first phase of the mine operation (1986 and 1987). Beginning in 1988, the mine is scheduled for full-time operation and, at that point, the mine and mill would employ about 150 people. Given the added need for services and the available income due to the mine and mill, secondary employment in the county would increase by about 45 persons by 1991.

Table III-17 presents the estimated employment by quarter from beginning construction to full operation employment. This employment schedule was used to estimate the number of persons who would move to Park County due to the project. Ten people currently employed by the Jardine Mining Company at the project site are included in the total mine operations employment.

Table III-17: Project Employment Schedule by Quarter

	1986			1987				1988	
Employment	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter
Construction	25	45	25	35	55	25	0	0	0
Mine operation	10	10	10	10	10	10	72	100	150
TOTAL	35	55	35	45	65	35	72	100	150

Source: Mountain International, Inc., 1984, Mitigation Plan, p. 38.

Population Projections

Estimates of project-induced in-migration were formulated for a low and a high series (see table III-18). The low series assumes that 20 percent of the mine and construction workers would come from outside the county. The high series assumes that 50 percent of the mine and construction workers would be from outside Park County and Mammoth, Wyoming. Each worker coming into the area was assumed to have 1.3 dependents.

In-migration was also estimated for mine-induced employment growth (secondary or nonbasic jobs). Only mine operations employment was assumed to generate secondary employment because the construction jobs are too short term to induce secondary job creation (Mountain International, Inc., 1984). (See Chapter III--Employment.) The low series estimate assumed that for every 5 mine operation jobs, 1 additional service sector job would be created; the high series assumed that 1 service sector job was created for each 3 mine jobs. Both projections lagged secondary job creation one year after mine operation employment increases. Each scenario also assumed that 20 percent of

Table III-18: Population and Employment Associated with the Proposed Project--Park County, Montana

Year	Construction employment in-migration		Mine operation in-migration		Mine-induced employment in-migration		Total	
	Low	High	Low	High	Low	High	Low	High
1986	15	37	0	0	0	0	15	37
1987	17	44	29	71	0	0	46	115
1988	0	0	36	90	6	9	42	99
1989	0	0	0	0	9	11	9	11
1990	0	0	0	0	0	0	0	0
TOTAL	32	81	65	161	15	20	112	262

Source: Montana Department of State Lands, unpublished working papers, June 1985.

mine-induced secondary jobs would be filled by newcomers to Park County with 1.3 dependents each.

The estimates prepared in table III-18 show that the total in-migrating population due to the proposed project is expected to be between 112 and 262 persons. Assuming that the migration would occur evenly over a 3- to 4-year period and that the average household size is 3.0 persons, there would be approximately 37 to 87 new households locating in Park County the first four years of the proposed project. Expected in-migration would peak in the second year, when 15 to 38 households would locate in Park County. Some of the construction-induced population increase would probably be temporary, and such workers and their families may leave Park County once the mine is on-line. If all nonlocal construction workers left Park County when the project is operational, total long-term in-migration would be between 80 to 181 people--or 27 to 60 new households.

The distribution of newcomers to the area would depend on housing availability in the Gardiner/Jardine area and commuting distances to Livingston. Some of the newcomers would settle in the Gardiner area, some in the Upper Yellowstone Valley area, and a smaller portion in Livingston. Because the migration would occur over a three-year period and because the expected number of new people would be small relative to the population base, there should be little change in the demographic environment of the area.

In-migration to the Gardiner/Jardine area would be influenced initially by housing availability and space availability for mobile homes and recreational vehicles (see Chapter II--Housing). Both are limited, so initial population impact in the Gardiner/Jardine area may be below the long-term impact if workers locate closer to the mine and as more housing is built to accommodate such relocation.

Social Life

Social Values. Impacts to social life are based predominantly on information in the Jardine Area Project Socioeconomic Impact Assessment, Volumes I and II, prepared by Mountain International, Inc. (1984).

Residents in the Gardiner area vary both in their perceptions of how the project may affect the area and in the importance they ascribe to these changes. Some residents of the Gardiner area may consider the quality of their lives diminished because of changes that could result from mining activity or from the increased population accompanying the project. The increased population; additional traffic, especially during construction; increased noise at the minesite from mine/mill construction and operation; impacts to the physical environment; and potential social conflict may be perceived negatively by area residents. The degree of such impacts and people's reactions to them are difficult to predict. Gardiner residents may perceive a deterioration in the quality of the natural environment; a faster pace of life; less friendliness among residents; or a reduction in the quiet, solitude, and privacy presently enjoyed in the area.

Jardine residents would be most likely affected by such changes because of their close proximity to the mine and their strong appreciation of the natural environment; the slow-paced life; the friendliness of neighbors; quiet, solitude, and privacy of the area; and the sparse population of Jardine.

Other residents may consider the quality of their lives improved because of expanded opportunities for employment and increased economic security. Individuals obtaining new employment as a result of the project, their families, and Gardiner area businesses would benefit from these changes.

Social Structure and Interaction. The impact of the project on the social structure and pattern of social interaction in the Gardiner area would be largely a function of the size of the in-migrating population. As the number of people migrating into the area increases, the potential for structural changes in the local social system rises. The process of absorbing in-migrants also may be slowed if the newcomers' histories are significantly different from, or incompatible with, the experiences of local residents.

At the community level, there would be little, if any, adverse impact to the social structure or patterns of social interaction if the following assumptions hold true:

--The applicant maintains a small work force (100 to 150 maximum) and hires a significant number (80 percent) of its work force locally.

--Newcomers' housing is scattered among current residents rather than concentrated in a few locations.

--Local residents are not threatened by newcomers and their lifestyles.

--The newcomers have similar demographic characteristics at the existing community (such as age, education, and marital status), have similar expectations of their community, and are relatively conservative in their personal life.

--The newcomers make a commitment to the local area such as buying homes and taking active interest in community affairs.

Social interaction may become more formal in the Gardiner area as the population increases. Depending on how well newcomers become integrated into the community, this formality may lessen. If newcomers are not integrated, they may form a new separate group and compete for power and status in the community. The social conflict present among local residents could increase if newcomers and locals have different attitudes toward the project.

The proposed project may reduce the importance of outside influences in Gardiner. Although the applicant would depend on the world market for the sale of its product, Gardiner would remain oriented to Yellowstone National Park, but to a lesser degree.

Economic Life. The seasonality and economic insecurity that characterize the Gardiner area would be reduced and local financial investment would increase if the project is built and operates without interruption. Underemployment of the local population would decrease if the applicant hires the majority of its work force from Park County. As the income of some local residents increases from direct mine employment or increased business, the relative economic status of other residents would decrease.

Temporary or early plant closure would lessen economic security in the Gardiner area and could cause economic hardship for employees and their families. While some workers might return to former employment, others may not be able to do so. Area businesses that expand, requiring increased, long-term business to finance such investment, could face economic hardship as well.

Political Life. The voting and individual political activities of the applicant's employees would have an indirect effect on local political life. The number of additional voters would depend on the number of nonlocal persons hired by the applicant, but would not likely tip local elections. The applicant would petition state and local governments on issues that would directly affect its operations; however, the applicant would not participate in partisan politics at the local level.

Social Problems. Anxiety may result from uncertainty about the changes that would occur with development of the mining project. Anxiety would be most probable among people living along the Jardine Road because these residents would be most directly affected by the physical changes caused by the proposed project.

Increases in mental-health, alcohol-treatment, and related caseloads would be very small and would not burden the existing treatment system. Any increase in these problems, however, would be important to the individuals affected and their families.

Residents of the Gardiner area may require the formal provision of services that are now provided informally, such as day care. Informal services in the community may be strained if a greater proportion of the population is employed full time.

The project would have no effect on Park County residents' civil rights. Other than enhanced job opportunities, the project would have no effect on minority groups or women.

Crime could increase in Park County because of the project. There would be occasional incidents involving members of the mine work force or members of their families of which the community would not approve. These incidents may include activities such as hunting violations or disorderly conduct.

Attitudes and Concerns. Groups concerned with the changes caused by the project include groups comprised of local residents and others with membership statewide and beyond. The introduction to this publication includes a list of public concerns.

Persons interested in the expansion of commercial services or cultural events may view the prospect of population growth in positive terms because an increase in the number of people can help support this expansion. Likewise, those persons interested in maintaining a pristine, natural environment or in the uncompetitive use of recreational resources may view a population increase as harmful. For those concerned about the quality of local schools and other government services, population growth can offer both opportunity and threat.

Mine Closure. Social life after the mine closes would depend on the number of people who leave the area, the demographics of the remaining population, the mix of people in the various social groups, and how well the mine-related population integrated into the community.

Community Services

Impacts to community services that would occur because of the proposed mining project are associated with increased migration into the area. Workers and their families would move in, establish residences, and exert an increased demand on community services. Predicting the impact of this increased demand, however, depends on knowing the exact numbers of newcomers and where they would settle.

Although it is not known where workers and their families would choose to reside, two factors would likely influence this choice. First is the limited number of houses, trailer parks, and homesites in the Gardiner/Jardine area. Second, there is a high monetary cost associated with securing a residence in this area. These factors would encourage settlement to the north in Corwin Springs, the Upper Yellowstone Valley, and Livingston (Andy Epple, Park County planner, pers. comm., May 3, 1985).

Unless existing housing is replaced by multi-family units, most newcomers would probably not settle in the Gardiner/Jardine area; therefore, impacts on community services would be reduced. The Upper Yellowstone Valley (Mill Creek, Emigrant, and Point of Rocks) has numerous undeveloped tracts available and Livingston has plenty of reasonably priced homes on the market. Community services for both the Upper Yellowstone Valley and Livingston are adequate to accommodate modest population increases in excess of what would be contributed by the project.

Law Enforcement. The Park County sheriff's department would be affected by the proposed project because of increased demands for law enforcement services. Increased traffic, vehicle accidents, and increased crime would aggravate the workload of existing deputies and could necessitate hiring additional staff.

The Park County sheriff and Park County citizens believe that an additional deputy would be needed after the mine opened. (Bob Oakland, Park County sheriff, pers. comm., April 1985). The sheriff, as well as other Gardiner residents, believes that the deputies are often overworked and unavailable in Gardiner when needed, and that two more deputies are needed--one even without the proposed project (Gordon LeFever, member, former Park County Planning Advisory Group; Dave Schreiber, member, Gardiner Concerned Citizens; Gardiner Chamber of Commerce, all pers. comm., April 1985).

Additional law enforcement problems in the Gardiner area could result with an influx of transients in search of employment. New developments, such as the proposed mine/mill complex, often attract unemployed persons who may commit crimes (Mountain International, Inc., 1984, Mitigation Plan, p. 92).

Crime in Park County would increase with the proposed project. Even if the applicant were able to hire 80 percent of the work force locally, criminal homicide, forcible rape, robbery, aggravated assault, burglary, larceny-theft, motor vehicle theft, and arson could be expected to increase (Bob Oakland, Park County sheriff, pers. comm., April 1985).

Increased commuter traffic on U.S. 89 as a result of the project would require additional law enforcement activities by the Montana Highway Patrol. During full employment years, mine-related traffic is projected to account for 8.3 to 12.3 percent of all traffic on U.S. 89. The number of accidents would increase an average of 7 per year (see Transportation, table III-24).

Education. The Livingston schools could accommodate the projected increase in enrollment due to the proposed project. The schools may experience a small increase in the budgets for instructional supplies, but little else would be affected (Mountain International, Inc., 1984, Mitigation Plan, p. 85).

The rural schools of Richland and Arrowhead are presently operating below capacity; therefore, enrollment increases would not seriously affect the school districts (Sonja Spannring, Park County Superintendent of Schools, pers. comm., May 1985).

The Gardiner residents presently enjoy what they consider a good-quality education for their children. This feeling is based primarily on the low student/teacher ratio (presently a low of 8 students/teacher and a high of 16 students/teacher). If the ratio were to exceed 23 students per teacher, the community would consider this increase unacceptable. However, if the enrollment projection is correct, the students coming into the district are not all one age, and if the Mammoth School does not close, the Gardiner School could absorb the projected number of in-migrating students and still maintain the present quality of education (Lynn Mavencamp, superintendent, Gardiner Public School, pers. comm., April 1985). The assumption would hold true if the newly constructed Gardiner High School were to have the same or greater capacity than the one that was destroyed by fire.

Fire Protection. The Livingston and Gardiner fire departments are adequately staffed and equipped to provide fire protection for newcomers. Residential developments in rural areas would receive fire protection from volunteers of the five rural fire districts.

The need for fire protection in the Jardine area would be increased with the mine/mill complex and the construction of new residences. The suppression of fires in mines requires skills and specialized equipment that the Gardiner fire department does not possess. In addition, the mobilization and travel time to move firefighters and equipment from Gardiner to Jardine is 15 to 20 minutes with good road and weather conditions--an unacceptably long time for "first line" fire protection (Mountain International, Inc., 1984, Mitigation Plan, p. 96).

The applicant has agreed to provide fire protection at the plant and to negotiate a contract with the Gardiner fire department to provide back-up fire protection.

The residents of Jardine, who are not presently in a fire district, would not be covered in the contract between the applicant and the Gardiner Fire Department (Carlo Cieri, Park County Commissioner, pers. comm., May 1985; Gene Kremer, Gardiner volunteer firefighter, pers. comm., April 1985). With additional risks of fire to the Jardine residents' homes because of the possibility of mill fires, the need for fire protection would become more critical with the project.

The Gardiner Fire District could extend its boundaries to include Jardine homes within the district. Such property would be taxed to provide funding for the increased service area (Mountain International, Inc., 1984, Mitigation Plan, p. 97). However, this alternative may not provide sufficient fire protection to Jardine homes, given the 15- to 20-minute response time from Gardiner. Equipment and volunteer firemen may need to be located closer to Jardine to provide adequate protection.

Ambulance. The applicant has agreed to provide an ambulance and certified emergency personnel at the mine site and would contract with the Gardiner volunteer ambulance service for support service. Therefore, no significant impacts are expected on existing emergency medical services in Gardiner.

More traffic accidents are expected to occur on U.S. 89 due to increased commuter traffic. The Livingston ambulance service (Community Lifeline) would be able to service this increase in emergency situations.

Hospital and Medical Personnel. The Livingston Memorial Hospital would experience a slight increase in the number of admissions primarily due to traffic- and mine/mill-related accidents. The hospital has adequate facilities and staff to meet this increased need for health services.

Accidents at the mine/mill complex and increases in highway accidents would require additional care by local Park County physicians. Existing facilities and physicians could accommodate expected demands for medical services.

Water Supply. Increased water demand associated with the mine/mill complex and new residences would have no adverse impact on municipal water supplies. Livingston and Gardiner are currently constructing new wells to ensure adequate water supplies for expanding domestic and industrial use as well as for fire protection.

Wastewater Treatment. There would be little impact on the existing Gardiner wastewater treatment facility because of the limited number of projected new residences in Gardiner. At or near the mine site, however, the mine/mill complex and the projected number of residences would create a need for disposal of wastewater (Olin Hart, Homestake Mining Company geologist, pers. comm., April 1985). A detailed engineering study would need to be conducted to determine the feasibility of installing a septic tank system (Roy Wells, Water Quality Bureau, Montana Department of Health and Environmental Sciences, pers. comm., May 1985).

Settlement in the Upper Yellowstone Valley would not exert demand on existing water treatment facilities because rural developments rely on septic tank disposal of wastewater. The burden of providing such treatment would be on the landowner and would not affect public treatment facilities.

The Livingston wastewater treatment facility is operating at below capacity. There is no expected impact by incoming workers and their families.

Solid Waste. There would be no significant impact for solid waste pick up and incineration except possibly at Jardine. Additional solid waste would be generated at the mine/mill complex and at residences of incoming mine/mill workers in Jardine. The disposal of the solid waste could pose a problem because without regular disposal and construction of chain link fences around collection bins, refuse would become an attraction for scavenging bears (Ed Flatt, operator/manager, Park County Incinerator, pers. comm., May 1985). The incinerator at Livingston is operating well below capacity and economic advantages would be realized if larger amounts could be burned to help defray the per-unit cost of the facility.

Social Welfare. Transient job seekers moving to Park County in search of work in the mine may increase the number of persons on welfare. Because the State of Montana has assumed the responsibility of the county welfare program, additional welfare costs would not adversely affect the Park County residents. Under the existing state system, a maximum 13.5 mill poor-fund levy is assessed against taxable property (Mountain International, Inc., 1984, vol. II, p. 89). If the poor-fund revenues do not sufficiently cover social welfare costs, the state pays the difference.

Housing. Due to the limited housing (that is, homes for sale, rental units, trailer courts) in the Gardiner/Jardine area, the existing market would be saturated by mine/mill workers and additional housing would need to be secured in rural areas between Gardiner and Livingston or in Livingston.

The number of housing units that would be required to accommodate permanent mine/mill workers and families would range from 30 to 75, depending on the number of non-local workers that would be hired (Mountain International, Inc., 1984, Mitigation Plan, p. 58). Considering the number of housing units and/or building sites available within commuting distance of the mine site, the influx of population as a result of the project would not unduly stress the market.

Increased demands for housing in the Gardiner area as a result of the project probably would increase rental rates, lot prices, and house prices

(Andy Epple, Park County Planner, pers. comm., May 3, 1985). Such increases would raise living costs for seasonal tourist industry employees and others. However, if developers built more houses, such increases would not occur. Competition from mine employees would render housing less available on a seasonal basis for the temporary work force.

Except for possible housing availability and cost issues, consumers in Park County would not be adversely affected by the project.

FISCAL CONDITIONS

Summary. The JJV project would increase tax revenues for Park County, both school districts in Gardiner, special service districts in Gardiner, and the state of Montana. Over the life of the project, and at current gold prices ($316.47 per ounce), the applicant would add between $986,000 and $2.6 million to the annual tax base of the Park County and both Gardiner school districts. The service districts in Gardiner would receive between $634 and $4,320 dollars in increased revenues at current rates for services, assuming that incoming workers build 15 new homes within the service district boundaries. The state would receive $329,148 annually from the mine at current gold prices.

Park County and Gardiner School Districts

Local property tax values would increase directly and indirectly due to the project. Direct increases accrue from capital improvements and equipment purchases made by the applicant and from the taxable value of the gold production by the project. Indirect tax increases occur due to persons moving to the county to take mining jobs. These persons may build homes and will acquire other taxable property.

Table III-19 shows the taxable value of the gold production from the Jardine Mine at various gold prices. Three percent of the gross value of the gold produced (gross proceeds) is taxable as Class II property. It is assumed that the applicant would produce 49,100 ounces of gold annually at full production. At such production rates and at current market prices for gold ($345.41 per ounce, March 14, 1985), $508,789 would be added annually to the tax base of Park County and both Gardiner school districts.

Table III-20 shows the expected total annual increase in taxable value due to the project. The taxable value would fluctuate as the project acquires new equipment and other capital improvements and as the value of such improvements depreciates. In 8 of the 23 years, the increase in taxable valuation would be greater than $2 million at current metal prices. In all other years except the final year, taxable valuation of the project would be over $1 million. The taxable valuation of the project would be influenced by the price of gold, and would vary from the values shown in table III-20 as the price of gold fluctuates.

Table III-19: Annual Taxable Value of Gross Proceeds at Various Prices of Gold[1]

Price per ounce of gold[2]	Gross value	Taxable valuation[3]
$250.00	$12,275,000	$ 368,250
300.00	14,730,000	441,900
345.41	16,959,631	508,789
350.00	17,185,000	515,550
400.00	19,640,000	589,200
450.00	22,095,000	662,850
500.00	24,550,000	736,500
750.00	36,825,000	1,104,750

[1] Annual average gold production would be 49,100 ounces (Mountain International, vol. 2, 1984, p. 133).

[2] The weekly average price of gold at the London market was $345.41 per ounce for the week ended March 14, 1986 as listed in Metals Week, March 17, 1986, p. 4. It is not known at what gold prices the project would be profitable.

[3] Gross proceeds taxable value is 3 percent of gross value.

Table III-20: Estimated Annual Taxable Value of the Project by Fiscal Year

Fiscal year	Capital investment[1]	Gross proceeds[2]	Total
1987	$ 846,450	$254,394	$1,100,844
1988	736,865	508,789	1,245,654
1989	653,605	508,789	1,162,394
1990	1,645,500	508,789	2,154,289
1991	1,517,861	508,789	2,026,650
1992	1,417,765	508,789	1,926,554
1993	1,281,041	508,789	1,789,830
1994	1,149,008	508,789	1,657,797
1995	2,096,260	508,789	2,605,049
1996	1,841,107	508,789	2,349,896
1997	1,667,885	508,789	2,176,674
1998	1,491,899	508,789	2,000,688
1999	1,359,824	508,789	1,868,613
2000	1,230,500	508,789	1,739,289
2001	1,102,862	508,789	1,611,651
2002	1,002,767	508,789	1,511,556
2003	1,942,659	508,789	2,451,448
2004	1,683,070	508,789	2,191,859
2005	1,480,620	508,789	1,989,409
2006	1,293,094	508,789	1,801,883
2007	1,243,581	508,789	1,752,370
2008	1,097,484	342,584	1,440,068
2009	985,994	-0-	985,994

[1] Source: Mountain International, 1984, vol. 2, p. 134, and DSL working papers, MArch 25, 1986.

[2] The price of gold is assumed to be $316.47 per ounce with an annual production of 49,100 during full operation.

Park County would also receive property tax revenues due to new mine workers locating in the county. Such indirect increases could range from $61,000 to $155,000 annually (Mountain International, Inc., vol. 11, p. 135).

Gardiner Special District Revenues and Costs

Special district revenues and costs would depend on the number of mine workers and their families who settle in Gardiner. None of the districts would need to undertake capital expansions or add staff in order to maintain existing service levels and extend service to newcomers (Mountain International, 1984, vol. 11, p. 155). (See also Chapter III--Community Services.)

Table III-21 shows projected costs and revenues for the Gardiner water, sewer, and fire districts, assuming that 96 people move to the Gardiner area due to the project. Only increases in variable costs are shown because fixed costs are already being recouped by the districts. Variable costs are also the most sensitive to changes in population.

Table III-21: Projected Revenues and Expenditures for the Gardiner Water, Sewer, and Fire Districts

	FY86	FY87	FY88	FY89	FY90	FY91
Water district						
Projected increase in revenue[1]	$2,592	$3,600	$4,320	$4,320	$4,320	$4,320
Projected increase in variable costs[1]	674	1,425	1,871	2,026	2,194	2,352
Surplus or (deficit)	$1,918	$2,175	$2,449	$2,294	$2,126	$1,968
Sewer district						
Projected increase in revenue[2]	$ -0-	$ 962	$1,924	$2,886	$2,886	$2,886
Projected increase in variable costs[2]	134	282	371	402	436	467
Surplus or (deficit)	$ (134)	$ 680	$1,553	$2,484	$2,450	$2,491
Fire district						
Projected increase in revenue[3]	$ -0-	$ 634	$1,268	$1,903	$1,903	$1,903
Projected increase in variable costs[3]	96	200	257	273	289	304
Surplus or (deficit)	$ (96)	$ 434	$1,011	$1,630	$1,614	$1,599

Source: Mountain International, Inc., 1984, vol. 1, p. 156.

[1] Based on average household water fee of $12.00 per month. Variable costs set at $14.02 per capita and escalated 8.3 percent per year.

[2] Based on current mill levy at 75 mills applied to taxable value of estimated 15 new homes. Variable costs set at $2.78 per capita and escalated at 8.3 percent per year.

[3] Based on current mill levy of 49.45 mills applied to taxable value of estimated 15 new homes. Variable costs set at $2.09 per capita and increased 6.1 percent per year.

The water district would experience revenue surpluses, which would begin to decline in FY91. As revenues from new residents stabilize and variable costs increase, the district may need to raise water charges in order to cover costs (Mountain International, 1984, vol. 2, p.157).

The sewer district would have a deficit the first year of the project. However, revenues (property taxes and service fees) are projected to cover service costs for the remainder of the forecast period, if an estimated 15 new homes were constructed.

The fire district would also have a deficit the first year of project operation. If 15 new homes were built in the Gardiner area, the district would be able to generate revenues in excess of costs through FY91.

Park County Solid Waste District

The Park County solid waste district can accommodate increased use without adding additional staff or increasing capital expense (Mountain International, Inc., vol. 2, p. 159). Table III-22 shows projected revenues and costs for the district.

Table III-22: Estimated Revenues and Costs for the Park County Solid Waste District FY87 to FY91 (1980 dollars)

Scenario	FY86	FY87	FY88	FY89	FY90	FY91
20 Percent nonlocal hire						
Projected increase in revenue[1]	$546	$1,066	$1,292	$1,292	$1,292	$1,292
Projected increase in variable costs[2]	123	259	337	363	389	414
Surplus or (deficit)	$423	$ 807	$ 955	$ 929	$ 903	$ 865
50 Percent nonlocal hire						
Projected increase in revenue[1]	$546	$1,532	$2,158	$2,158	$2,158	$2,138
Projected increase in variable costs[2]	123	372	563	606	650	691
Surplus or (deficit)	$423	$1,160	$1,595	$1,552	$1,508	$1,447

Source: Mountain International, Inc., 1984, vol. 2, p. 158.

[1] Revenues are based on $15.00 per ton tipping fee. Additional revenues are possible through property taxes, if necessary.

[2] Costs are based on variable cost of $2.93 per ton escalated at 7.5 percent per year.

The projections are given for a high and low population growth associated with the project. The low-impact scenario assumes 20 percent nonlocal hire, while the high scenario assumes 50 percent nonlocal hire. In both instances surplus revenues are generated that peak in FY89. The greater the number of nonlocal persons hired by the applicant, the higher the surplus revenues would be.

If revenues were to continue to decline after FY91 and costs continued to increase, the district could raise collection fees. If necessary, the district could also levy property taxes (Mountain International, Inc., 1984, vol. 2, p. 158).

State Revenues

The state would receive two revenues from the proposed project--the metal mines license fee, and Resource Indemnity Trust taxes (RIT). Both are based on the gross value of mineral production. The metal mines license tax is graduated with taxation rates on the gross value of production of a) 0.5 percent of the amount between $250,000 and $500,000, b) 1.0 percent of the amount between $500,000 and $1 million, and c) 1.5 percent of the amount in excess of $1 million. The RIT is 0.5 percent of the gross value in excess of $5,000 or $25 for mines producing up to $5,000 worth of minerals.

Table III-23 shows annual tax revenues generated by the project at selected prices of gold at full production (49,100 ounces per year). At recent gold prices ($345 per ounce), the project would contribute $329,148 annually at full production to the state. Over the life of the project, assuming a price of gold at $345 per ounce, the mine would pay $5.21 million in metal mines license fees and $1.79 million in RIT.

Table III-23: Annual Jardine Joint Venture Project Tax Revenues at Selected Gold Prices

Price of gold[1] per ounce	Gross value (millions)	Metal mines license tax	Resource indemnity trust tax	Total
$250	$12.275	$175,425	$ 61,375	$236,800
300	14.730	212,200	73,650	285,850
345.41	16.935	244,474	84,674	329,148
350	17.185	249,025	85,925	334,950
400	19.640	285,850	98,200	384,050
450	22.095	322,675	110,475	433,150
500	24.550	359,500	122,750	482,250
750	36.825	543,625	184,125	727,750

Source: Mountain International, Inc., vol. 2, p. 149 and Department of State Lands.

[1] The break-even or profitable price of gold for the project is not known. The March 1986 gold price was $345.41 per ounce (Metals Week, March 17, 1986, p. 4).

Mitigating Measures Hard Rock Mining Impact Mitigation Plan

--Developers of large-scale hard rock mines or associated milling facilities are required by law to prepare a fiscal impact plan describing the impacts that a proposed development will have on units of affected local government (90-6-307, MCA). The plan will include the estimated number of persons expected to come into the affected area, the increased capital and operating costs to units of local government, and the financial or other assistance that the developer will provide to such governments (90-6-307[1], MCA). Developers are required to pay all increased capital and net operating costs to affected local government units (90-6-307[2], MCA).

--State law also contains tax-base-sharing provisions designed to distribute tax revenue among counties, municipalities, and school districts according to the number of mineral-development employees living within the jurisdiction. Municipalities may receive a portion of the taxable value not to exceed 20 percent; such portion is to be distributed among municipalities according to the percentage of the total number of mineral-development employees living in each municipality. The remaining portion of taxable value must be distributed among each affected county according to the percentage of mineral employees living in each county. High school and elementary districts receive a pro-rata share of the taxable valuation of the hard rock mine according to the percentage of the total number of mineral-development students living in each district (90-6-404, MCA).

--The applicant prepared an impact plan that was accepted by Park County. The plan analyzed the potential for impacts to Park County, Gardiner school districts #4 and #7, the Gardiner water and sewer districts, the Gardiner fire district, and the Park County Refuse Disposal District. The city of Livingston and Paradise Valley were not included in the impact plan document analysis; estimated population increases in these areas are not expected to cause projected service cost increases above associated revenues (Mountain International, Inc., 1984, Impact Plan, pp. 16-17).

--The applicant would provide total assistance of $526,000 to Park County in the form of tax prepayments. The applicant would provide $15,000 to the sheriff's department for communication or other equipment and $500,000 to upgrade the Jardine Road. The applicant would negotiate contracts with the Gardiner ambulance and the Gardiner fire district to provide back-up service at the project site. The fixed annual fees would be negotiated (Mountain International, Inc., 1984, Mitigation Plan, pp. 61, 98, and 123).

--Grants and loans from the hard-rock mining impact trust account are available to units of local government when a mining operation has permanently ceased operations or has reduced its full-time equivalent mining work force by 50 percent over the preceding 5-year period (90-6-321[1], MCA). (See Chapter III--Fiscal Conditions.) The Hard-Rock Impact Board may award grants and loans to pay for outstanding capital project expenses, to decrease unusually high property tax revenues, and to promote development of new industry or new employment opportunities in the area (90-6-321[2], MCA).

LAND USE

Summary. Land use would not change substantially in Park County due to the project. Reclamation of surface disturbance within the permit area would be planned so as to establish suitable wildlife habitat and livestock grazing land after mine closure (see Chapter III--Vegetation). Within Park County, up to 19 acres of agricultural land could be converted to residential uses if incoming mine workers chose to construct new homes.

Direct Land Use Impacts

The surface disturbance associated with the tailings and waste rock dump would destroy 67 acres of native vegetation and 26 acres of previously disturbed land. Reclamation of disturbed areas would eventually provide suitable wildlife browse, habitat, and livestock grazing land (see Chapter III--Vegetation and Wildlife). The power line would disturb a small amount of roadside vegetation. Depending on the centerline chosen, the power line could cross private property.

Conflicts between mining land uses and recreational land use in the Jardine area should be minimal. Mining traffic on the Jardine Road may interfere with recreational sightseers and with hunters. Mining may also cause elk and deer to avoid historic habitat until they are accustomed to the increased noise and activity. Such habituation may take some time, but would not cause significant impacts to the late-season elk hunt (see Chapter III--Wildlife and Transportation).

Indirect Impacts

Indirect land use impacts would occur due to people moving into Park County to take mining jobs and subsequently build new homes. Conversion of agricultural land to residential uses would depend on the number of nonlocal employees hired by the applicant and the housing preferences of such employees.

Between 7.5 and 19 acres of agricultural land could be converted to residential uses. Such figures assume that each residence uses 0.25 acres, that there are 30 to 75 nonlocal employees who are hired by the project, and that each builds a new home.

TRANSPORTATION

Summary: The project would cause increases in traffic and accidents on FAP 78 and the Jardine Road. Traffic increases on FAP 78 would be moderate. Impacts to the Jardine Road would be variable. The JJV plan to reduce traffic would cause an increase of up to 84 vehicle trips per day on the county road. Such an increase would be minor compared to times when the road experiences heavy recreational use. Mine traffic would be highly visible during periods when the road is being used primarily by

local area residents. However, mine traffic would be scheduled to avoid peak use of the road by local area residents driving to and from work and by school buses.

Cumulative impacts on the Jardine Road and U.S. 89 due to proposed timber sales would be negligible. Two sales are planned for 1989 to 1994. The first sale would generate six additional vehicles per day on each road and the second would add about four vehicles per day.

Project Traffic. Transportation impacts from the proposed project would come from three sources--employees commuting to work, supply and ore trucks traveling to and from the mine, and newcomers traveling from home to work or other household supply trips. The transportation impacts would affect U.S. 89 and the Jardine Road. Mine-related traffic would increase and reach a plateau when the mine and mill are in full operation, assumed to be year 3 of the project for this analysis.

Table III-24 shows the number of project employees by shift for various employment levels. Weekend project staffing would consist of a mill crew and security (Mountain International Inc., 1984, Impact Statement, p. 118). A total of 138 workers would commute to the mine and mill each weekday.

Table III-24: Weekday Distribution of Workforce by Shift at Various Employment Levels

Number of employees	Day shift 9 a.m. - 3 p.m.	Afternoon shift 3 p.m. - 11 p.m.	Night shift 11 p.m. - 7 a.m.
150	84	50	16
125	70	42	14
100	56	33	11
75	42	25	8
50	29	16	5

Source: R.T. Agar, Vice President, ACNC, pers. comm., January 22, 1986.

A second source of traffic increases related to the mine would come from household supply trips to Gardiner or Livingston; a trip to the grocery store is an example. The number of mine-related household trips generated would depend on the number of nonlocal people hired by the applicant, the number of newcomers who choose to reside in Gardiner or south of Livingston, and the number of local workers who relocate closer to the minesite in Gardiner or south of Livingston.

The third source of traffic generated by the mine would include vehicles driving to and from the mine with supplies. Supply truck trips would peak in

1987 during mine construction and would taper off to about five round trips per day after the mine is on line (R.T. Agar, Vice President, ACNC, pers. comm., January 23, 1986).

JJV Commitment to Implement Traffic Reduction Plan

The applicant has designed and committed to the implementation of a traffic mitigation plan or the Jardine Road. When project employment reaches 50, cash incentives would be offered to drivers who carpool. The amount of the cash bonus would be based on the number of passengers per car. When employment reached 100, the applicant would institute a bus service between Gardiner and Jardine. Only vehicles with a company-issued decal would be allowed to park at the project site. Fifty decals would be issued to employees based on seniority. The county would allow JJV employees to park on county-owned land near the airport to catch the bus (R.T. Agar, Vice President, ACNC, pers. comm., February 6, 1986).

In addition to the above measures, Park County and the JJV have agreed in the hard-rock mine impact plan to upgrade the Jardine Road once the JJV obtains a mine permit and decides to proceed with project construction. The JJV would provide the county with $500,000 in tax prepayments to upgrade the road. A feasibility study would be completed to determine the exact location and type of improvements to be undertaken. It is anticipated that the road grade would be reduced in certain locations, sight distance would be improved through some curves, guardrails would be installed, and drainage and dust-control measures would be implemented (R.T. Agar, Vice President, ACNC, pers. comm., February 6, 1986).

U.S. 89

Table III-25 shows the projected average daily traffic (ADT) and accidents on U.S. 89 due to the project, and the percentage increase above projected ADT and accident levels without the mine. Project-related traffic and accident increases are based on an extreme case of worker location assumptions. It was assumed that 15 workers and their families would locate in Gardiner with the balance of the work force locating in Livingston. Commuting patterns were based on the shift schedule in table III-24 and it was assumed that workers carpooled with two persons per vehicle. Household trips were estimated to be six round trips to Livingston per project worker household each week. The number of mine-supply trips was assumed to be five round trips per day (R.T. Agar, Vice President, ACNC, pers. comm., January 22, 1986).

Mine-related average daily traffic (ADT) on U.S. 89 would create a 12.3 percent increase above projected ADT without the mine during the first year of operation. Project-related traffic would account for a decreasing percentage of daily traffic on U.S. 89 throughout the life of the mine due to expected growth in traffic without the mine. During 2005--the final full year of mine employment--project-related traffic would produce an additional 8.3 percent daily traffic. These traffic increases represent extreme-case conditions. Actual traffic increases on U.S. 89 would be lower if mine worker vehicles carried more than two people per car.

Table III-25: Estimated Traffic and Accident Increases on U.S. 89 Due to the Project[1]

	Projected average daily traffic[2]			Estimated number of accidents[3]		
Year	Without project	Added by project	Percent increase	Without project	Added by project	Percent increase
1988[4]	1,080	133	12.3	51	7	13.7
1990	1,132	133	11.7	57	7	12.3
1995	1,273	133	10.4	64	7	10.9
2000	1,432	133	9.3	72	7	9.7
2004	1,611	133	8.3	81	7	8.6
Total for Period of full Employment[5]	NA	NA	NA	452	114	25.2

Source: Department of State Lands, unpublished working papers, February 1986.

[1] See table II-44 for development of estimates of traffic accidents and fatalities without project.

[2] The ADT with-project estimates assume peak employment of 150 and that 15 employees locate in Gardiner and the balance would locate in Livingston, which would produce an ADT representative of extreme conditions.

[3] The with-project accident estimate used the statewide rate of 2.67 accidents per million miles driven (1977-1982).

[4] Full employment for the project would last from 1988 to 2005.

[5] Totals include each year of the forecast period and would be larger than the sum of each forecast point.

NA means not applicable.

Project-related traffic increases would be estimated to cause an additional 114 accidents over the full employment period of the mine life (see table III-25). Accidents were estimated using the statewide rate of 2.67 per million vehicle miles driven, which is higher than the average for U.S. 89 south of Livingston. These estimates may overstate actual accidents once the project is on line, if accident rates on U.S. 89 remain lower than 2.67 accidents per million vehicle miles driven. However, traffic increases can contribute to higher accident rates, so the higher statewide rate was used in estimating accidents.

Project-related traffic should not cause a significant number of highway fatalities. An increase of two fatalities over the life of the mine is estimated to occur, using the 1972 to 1982 rate on U.S. 89 of 4.27 fatalities per one hundred million miles driven.

The extreme-condition analysis could occur if the JJV traffic plan failed to influence workers to carpool from Livingston to Gardiner. However, the vehicle parking pass restrictions could encourage carpooling from the origin to the minesite. If the JJV program initiated a ridership of 3 workers per vehicle, the ADT and traffic accident increases would be lowered by 30 percent. Increasing ridership to 4 workers per vehicle would lower project ADT and traffic accidents by over 50 percent.

Jardine Road

At peak employment, mine-related traffic would add up to 83 more vehicles on the Jardine Road each day. This increase is 30 to 50 percent smaller than traffic estimates originally included in the DEIS because the JJV has committed to a traffic reduction plan. In addition to the planned improvements to the Jardine Road and the scheduling of shift changes to avoid times of other peak public use, the traffic reduction plan would greatly offset traffic hazards due to the project. JJV traffic would be most noticeable in the seasons when tourism and recreational use of the road is low. However, during the late-season elk hunt, JJV traffic at peak employment may add only 20 percent to high recreational use traffic (Park County, unpublished traffic county data, December 1985).

Quantifying the impact of the JJV project on the Jardine Road is difficult. Traffic counts have been made for the road (see Chapter II--Transportation); however, such data are so irregular and so infrequent that they are not useful in projecting baseline traffic conditions or project impacts.

The JJV has mitigated a large part of the public safety hazard associated with the use of the Jardine Road by the traffic mitigation plan, planned improvements to the road, and timing of the shift changes. All three steps combine to greatly reduce potential traffic impacts predicted in the DEIS.

Cumulative Impacts

There would be minimal increases in average daily traffic on the Jardine Road and U.S. 89 due to timber sales planned by the U.S. Forest Service from 1987 through 1996.

RECREATION

Summary. The project would have little direct impact on National Forest recreation areas.

Secondary impacts from the project could include increased use of the National Forest due to newcomers in the project area. The project estimates a work force of 150 employees; the local population is projected to fill 120 of these jobs, with 30 new workers coming into the area. The movement of locals into project jobs would probably create other job opportunities that would be filled by new workers to the area. The addition of 150 new workers would no doubt increase recreation use in the National Forest surrounding the project. However, compared to present and projected numbers of recreation visitors, the impact would be quite small. In addition, most camping in the past occurred at Eagle Creek campground; no changes from this pattern are expected. The increased demand on National Forest-area campgrounds could be accommodated.

The National Forest near the project area is key winter big game range. To prevent harassment of game while on the winter range, the Forest Service has adopted travel restrictions for motor vehicles. With an increased local population, restrictions on non-motorized use may also be needed to prevent harassment of big game.

CULTURAL RESOURCES

Summary. The project would cause up to 16 structures in the proposed Jardine Historic District to be removed. The loss of structures in addition to construction of new facilities would alter the appearance of the historic mining area.

A number of buildings would be destroyed within the permit area. Structures associated with the original portal would be removed to facilitate opening a new portal. The frame compressor house (structure 41) and frame blacksmith shop (structure 41) are considered significant historic structures, but are in poor condition. The tram control house (structure 40), a frame outhouse (structure 45), two frame shacks (structures 46 and 47), a frame and metal office (structure 49), and a frame "dry house" (structure 50) are all contributing structures in either poor or very poor condition.

Construction of the shop and warehouse would remove the frame and concrete powerhouse (Structure 39), a contributing structure in good condition. The laboratory and mill would displace four structures: wooden fly-wheels (Feature 51), a wooden sluice box (Feature 52), miscellaneous frame structures (Feature 53), and a frame electric substation (Structure 54). All are in poor condition. The substation is a significant historic structure and the others are all contributing structures. A collection of concrete foundations (Structure 35) in poor condition would be covered by the proposed ore stockpile. A frame assay office (Structure 58) and wooden cyanide vats (Structure 61), both contributing structures in poor condition, would be removed during construction of the parking area.

The arsenic plant (Structure 59) is a significant historic structure located outside the anticipated impact area. The applicant plans to remove the building if studies show that it is a health hazard. The site was submitted for addition to the Environmental Protection Agency's Emergency and Remedial Response Information System list in 1979 because it may contain hazardous waste materials (Sara Weinstock, Montana Solid and Hazardous Waste Bureau, pers. comm., May 14, 1985). The arsenic plant is in poor condition and contains arsenic-laden materials.

All other structures in the area would not be affected directly by the operation. However, increases in vehicle traffic and the number of people could physically degrade buildings, either inadvertently in the case of an accident, or purposefully in the case of vandalism or souvenir collecting.

AESTHETICS

Summary. Although the Jardine area has been disturbed by previous mining, the applicant's project would be highly visible to local residents and visitors traveling to

Jardine and upstream Bear Creek. The milling building, crushing facilities, and tailings pond would be the most evident features. Travelers on the Jardine Road would notice the line supplying power to the mine.

Due to the surrounding hills, the operation would be visible from within 1.2 miles when approaching Jardine on the county road. Travelers on the Jardine Road would notice the power line running along the road's adjacent uphill slope, but the power line would not interfere with views of Yellowstone National Park. Jardine-area residents may object to the power line as a part of the scenery. The mine could be seen in the background from some areas of Yellowstone Park--Mammoth terraces and Mammoth Hot Springs Hotel, for example.

After mining is complete, all structures except the power line would be removed and all disturbed areas revegetated. The tailings impoundment would probably still be recognizable as differing from the surrounding landscape.

During the 18-month construction period for the mine and related facilities, noise levels would increase in the Jardine area, with heavy equipment the major noise source. Assuming that construction would occur only during daylight hours, the noise would not annoy most local residents.

During operation of the mine, noise levels would increase substantially near the mill. Noise levels at 10 feet from the mill should be about 75 decibels (dB[A]), assuming the building attenuated about 15 dB(A) of the inside noise (ACNC, pers. comm., February 18, 1986). Because noise levels decrease at about 6 dB(A) for every doubling of distance from the source (Loucks, 1973), noise levels would approach background levels at about 320 feet from the mill. Noise levels at various distances are shown in table III-26. These noise levels would be maintained throughout the day and night because the mill would be in continuous operation.

Table III-26: Noise Levels at Various Distances from the Mill

Distance from mill (feet)	Noise level (decibels)
10	75
20	69
40	63
80	57
160	51
320	45
640	39
1,280	33

[1] These levels will vary according to topography, wind, and vegetation in the area.

Mitigating Measures

--The applicant would paint structures relating to the project to blend with the natural environment.

Chapter IV: Impacts of the Alternatives

The Montana Department of State Lands and the U.S. Forest Service have analyzed alternatives to various parts of the applicant's proposal. This chapter evaluates alternatives to the applicant's proposed use of the Jardine (county) Road and the proposed power line corridor identified in Chapter I.

County Road Alternative

Alternative A to the existing county road (see figure I-3) would begin near the airport and gradually climb the steep hillside north of Gardiner until it connected with the county road above Z-Hill.

The lower Jardine Road and Z-Hill would still experience mine-related traffic (the Z-Hill would not be closed by Alternative A). Mine-related traffic through the residential and business areas of Gardiner would be less predictable and could even be greater than would occur with the proposal. The Z-Hill would continue to be a significantly hazardous section of road because road improvements would not be made to upgrade its safety. Without dust-control measures proposed by the applicant, ambient air quality along the lower Jardine Road could also be poorer due to increases in traffic. A new road would also disturb some wildlife habitat and would be highly visible from surrounding areas. The road would provide access through big-game winter range and an elk concentration area (see figures II-12 and II-14).

Power Line Corridors

Two alternative power line corridors are considered by the agencies to be feasible (see figure I-4). Exact centerline for the power-line corridors would be determined after further site study by the Montana Power Company (MPC) and the Forest Service. Similar to the proposal, the existing 12.5-kV power line would be removed.

Corridor Alternative 1 would follow the existing power line route through Gardiner to Blanding Station and up Bear Creek to Jardine. The existing 12.5-kV line would be replaced by a 69-kV power line. Existing poles would be replaced with poles 10 to 15 feet taller. Span lengths would increase to 300 feet in Gardiner and 360 feet outside of Gardiner. Alternative 1 could require construction of a road in Bear Creek to install and maintain the power line. However, the U.S. Forest Service would probably require it to be built without construction of any new roads.

Surface disturbance associated with a road would be a potential sediment source to Bear Creek. Depending on the degree of sediment loading, aquatic life could be affected. Without a road, however, the power line would not cause sedimentation in Bear Creek. Construction activity and taller poles in the town of Gardiner may be objectionable to some people. The lower sections of the new line, like the existing line, would be unsightly to some east-side Gardiner residents. The power line would be visible from the Z-Hill Road and along portions of the Jardine Road to near Blanding Station. The power line in the Bear Creek drainage would not be visually noticeable from the Jardine Road. Degradation of radio and television reception in Gardiner is a concern; however, special line testing would be needed before a determination could be made with certainty.

Corridor Alternative 2 would share the same corridor as the proposed corridor east of the Gardiner substation to the Jardine Road. The route would then cross the Jardine Road north of Blanding Station and continue east along the rolling hills to Bear Creek, where it would cross the creek immediately and follow the existing power line route in Bear Creek to Jardine. The power line would be visible for a distance west of the Jardine Road, where it crosses the road and for a short distance before dropping off into Bear Creek. At this point, the power line would not be noticeable from the Jardine Road. The relatively flat topography along the corridor would allow construction without requiring roads or other surface disturbance. Most, if not the entire line, could be constructed without roads or by using existing roads. Disturbance of wildlife habitat would be minimal.

Table IV-1: Comparison of the Power Line Alternatives

Proposal[1]	Alternative 1	Alternative 2
Potential eagle collisions	Highly visible by east Gardiner residences and from the lower Jardine Road	Moderately visible from Jardine Road
Highly visible from Jardine Road and Eagle Creek Campground	Potential for sedimentation in Bear Creek	
Highly visible by Jardine residences		

[1] Refer to Chapter III (Threatened and Endangered Species and Aesthetics)

Chapter V:
Denial of the Permit

Chapter III describes the impacts of the applicant's proposed project. This chapter analyzes the effects if DSL were to deny the permit.

If DSL were to deny the permit, the scenario described in Chapter II: The Existing Environment would continue unchanged. However, denial of the permit would not necessarily preclude future applications for mining or development in the Jardine area. The effects of a permit denial are listed below.

Effects to the Physical Environment

As a result of permit denial, the water quality and quantity in Bear Creek would remain unchanged, and the geology, soils, and vegetation of the area would remain undisturbed. The proposed depletion of water from Bear Creek would be avoided; this water could be used to maintain minimum instream flows during periods of short supply. Sediment loading to Bear Creek resulting from earth moving and project construction would not occur. Soil erosion predicted on waste rock dump slopes would not occur. Problems normally confronted during revegetation (introduction of weeds, for example) would be avoided because revegetation would not be necessary. The topography and scenery would continue to look as it does today.

Wildlife habitat would remain in its present condition. Current rates of poaching, antler collecting, and road-killed wildlife would not change. There would be 150 fewer people in the project area; therefore, encounters and conflicts between people and grizzly bears would occur at their current pace.

If the permit were denied, 26 acres of previously disturbed vegetation and wildlife habitat would not be reclaimed. Existing tailings in the area would also remain. Revegetation of these tailings would not occur without the project. Therefore, dust emissions from these tailings would continue about the same as today; the wind occasionally blows the tailings into plumes that sweep the area. Because the two existing tailings dumps would not be relocated, loading of arsenic and heavy metals to Bear Creek would continue at present levels.

Effects to the Economic and Social Environment

Denial of the permit would eliminate the potential employment and income benefits associated with the project. Area residents would lose the potential for 172 to 185 new jobs. Park County would not receive the estimated $4 million in annual income during the life of the mine. Park County and both Gardiner school districts would not collect the potential $2.6 million that the project would add to the annual tax base. Montana would not be able to collect increased taxes from the mining project.

Gardiner and Jardine residents would probably not experience an increase in social pressure that could otherwise result from new workers and their families moving into the area. In addition, less stress would be imposed on housing and community services. Social conflict regarding the project would end. Nineteen acres would remain in agricultural use or other uses instead of being converted to residential uses. Average daily traffic trends would continue at current levels. The estimated 114 accidents on U.S. 89 caused by project-related traffic would not occur; both U.S. 89 and the Jardine Road would have less traffic congestion without the mining project. However, without the project, the Jardine Road would probably not be improved in the foreseeable future.

The Jardine Historical District would remain in its present condition; the 21 structures the would have been destroyed by the project would remain undisturbed. These include three "significant" historic buildings.

Chapter VI: Resource Commitments and Land Uses

--The Jardine Joint Venture project would remove about 750,000 ounces of gold. Some ore would not be mined due to its low grade and the limits of available mining technology. The mine would provide tax revenues to Park County, the state of Montana, and several Gardiner-area jurisdictions.

--Some agricultural land would be converted to residential uses. Up to 19 acres of agricultural land could be permanently removed from production. Mill waste tailings, over thousands of years, could be introduced into Bear Creek due to erosion. However, the applicant proposes to clean up potential pollution sources that would degrade water quality and aquatic life in Bear Creek. This action would be considered an overriding positive benefit (see Chapter III--Geology).

--Long-term reductions in soil quality would be minimal or negligible. Over the next 20 years, about half of the soils that would be disturbed would deteriorate in quality due to prolonged storage. After reclamation, soil quality would improve with time and eventually reach premining levels.

--During the 20-year life of the mine, a pipeline break or a spill could contaminate the ground or surface water resources in the Bear Creek Basin. However, the impact on the environment would be temporary. Reclamation of the two existing tailings ponds would enhance existing ground and surface water quality. Total suspended sediment would increase by 3 percent over baseline. Cumulative impacts from mining and clearcutting would result in an increase in total suspended sediment of 9 percent over baseline.

--Irretrievable commitments of water resources would include a depletion from Bear Creek of 0.033 to 0.073 cubic feet per second as well as an increase in total suspended sediment between 6 percent and 485 percent over baseline during the first three years of development.

--Proposed revegetation would reduce forested land by 15 acres. Reestablished forests would also contain smaller trees than the premining forests. As time passes, planted and invading trees would reach premining heights and forest acreage would increase. Total plant production would increase while, in some areas, diversity would decline. Both production and diversity would eventually approach premining levels.

--While the mine operates, habitat loss and mining activity would displace wildlife (including threatened and endangered species) from the permit area and adjacent habitats. Wildlife may eventually become accustomed to mining activities and use habitats near the disturbance area. After the mine closes, revegetation would allow wildlife to return to the area. However, years would be required to return browse and cover species to levels provided by premining, native habitats. Indirect impacts (such as increased recreation, poaching, and road kills) would decline over the long term if mine closure decreases the local population. Habitat losses due to logging would slowly be remedied by natural revegetation.

--Traffic increases due to the mine would contribute to 114 additional accidents and an unknown number of fatalities on U.S. 89 between Livingston and Gardiner. Traffic increases could also cause more accidents and traffic fatalities on the Jardine Road.

--The action proposed by the applicant would alter the nature of social and economic life in Gardiner and Park County. Some residents would view the changes as beneficial; others would view them as decreasing well-being.

--The proposed project would change the character of social and economic life in Gardiner through the introduction of new people to the region and through its stimulus to commerce.

--Those individuals who have chosen to reside in the Gardiner area to escape urban life and enjoy Gardiner's relative isolation may be concerned that mine development would restore what they sought to leave. Gardiner would, however, continue to be a small town whose natural and social amenities remain intact.

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Chapter VIII: Consultation and Coordination

RESEARCH AND WRITING

The following people prepared the EIS:

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Jerry T. Light, Wildlife Biologist, USDA Forest Service
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Sherm Sollid, Geologist, USDA Forest Service
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Lois Steinbeck, Economist
- B.S. Economics, Colorado State University, 1977

Kit Walther, Project Chief

- B.S. Zoology, University of Montana, 1966
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REVIEW

The following people from the Department of State Lands reviewed this document:

Gary Amestoy, Reclamation Division Administrator
Chuck Baltzer, Geologist
Ed Gensler, Geologist
Terry Grotbo, Hard Rock Bureau Chief
Gary Lynch, Range Scientist
John North, Legal Counsel
P. Dennis Smith, Hydrologist

The following people from the USDA Forest Service reviewed this document:

Mike Burnside, Geologist
Ron Escano, Wildlife Biologist
Steve Glasser, Hydrologist
Ed Heist, Land Management Planner
Rich Inman, Range Conservationist
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Ross MacPherson, Forester
Susan Marsh, Landscape Architect
Doug McClelland, Civil Engineer
Tom Puchlerz, Wildlife Biologist
Mike Ryan, Archaeologist
John Sandmeyer, Land Management Planner
Henry Shovic, Soil Scientist
Norm Yogerst, Soil Scientist
Roger White, Civil Engineer

PEOPLE, AGENCIES, AND COMPANIES CONSULTED

The following people and companies (other than those cited in the text) provided information used to analyze the Jardine Joint Venture project:

Montana State Board of Education, Helena (State Historic Preservation Program)

Montana Department of Administration, Research and Statistical Services (Helena)

Montana Department of Commerce, Economic and Community Development Division (Helena)

Montana Department of Commerce, Hard Rock Mining Assistance Board (Helena)

Montana Department of Fish, Wildlife and Parks (Helena)

Montana Department of Health and Environmental Sciences, Air Quality Bureau and Water Quality Bureau (Helena)

Montana Department of Justice, Highway Traffic Safety Section (Helena)

Montana Department of Highways, Planning and Research Bureau (Helena)

Montana Power Company

Park County Planning Office (Livingston)

U.S. Army Corps of Engineers

REVIEW OF THIS STATEMENT

In accordance with environmental law, copies of the draft EIS were sent to the public for comments and suggestions. All comments were carefully considered by the agencies in preparing the final EIS. If necessary, changes were made in the text in response to some comments. In addition, responses to the comments are detailed in Chapter IX.

The Jardine Joint Venture EIS is available for review in the following places:

Montana Department of State Lands, 1625 11th Avenue, Helena, Montana

Gallatin National Forest, Supervisor's Office, Federal Building, Bozeman, Montana

Montana State Library, 1515 E. 6th Avenue, Helena, Montana

Park County Library, 228 W. Callender, Livingston, Montana

Gallatin National Forest Ranger Station, Gardiner, Montana

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Chapter IX: Public Comment and Agency Responses

The agencies received 32 letters commenting on the EIS. In addition, at the public hearing held in Gardiner, 15 people presented verbal testimony. Starting on the next page, this chapter reproduces each letter and testimony in full. Alongside each letter and testimony are the agencies' responses.

LETTER 1	U.S. Department of the Interior-- Geological Survey
LETTER 2	The Great Bear Foundation
LETTER 3	William K. Almond
LETTER 4	Gerald B. Bowles
LETTER 5	Wildlife Management Institute-- Daniel A. Poole
LETTER 6	Montana Department of Health and Environmental Sciences
LETTER 7	Park County Commissioners
LETTER 8	Crevasse Mountain Mining Company Board of Directors
LETTER 9	Montana State Historic Preservation Office
LETTER 10	Clarence Johnson
LETTER 11	Greg Vandersink
LETTER 12	Montana Department of Natural Resources and Conservation
LETTER 13	American Copper & Nickel Company, Inc.
LETTER 14	Montana L. Lindstrom
LETTER 15	Department of the Army
LETTER 16	Bob Gresswell
LETTER 17	The Bozeman Environmental Information Center
LETTER 18	Montana Chamber of Commerce
LETTER 19	Montana Department of Fish, Wildlife & Parks
LETTER 20	U.S. Department of the Interior-- Office of Environmental Project Review
LETTER 21	Gardiner Chamber of Commerce
LETTER 22	Gallatin Wildlife Association
LETTER 23	U.S. Environmental Protection Agency
LETTER 24	George Ommundsen
LETTER 25	Kathryn M. Johnson
LETTER 26	Greater Yellowstone Coalition

LETTER 27	Peggy Reich
LETTER 28	Montana Wilderness Association
LETTER 29	George H. Athias
LETTER 30	Montana Mining Association
LETTER 31	Montana Department of Highways
LETTER 32	Northern Plains Resource Council
TESTIMONY 1	Bill Hoppe
TESTIMONY 2	Sue Johnson
TESTIMONY 3	Linda Collins
TESTIMONY 4	Miriam Skertich
TESTIMONY 5	Jim Marty
TESTIMONY 6	Bob Gresswell
TESTIMONY 7	Richard Parks
TESTIMONY 8	Joyce Ludwig
TESTIMONY 9	Clarence Johnson
TESTIMONY 10	Bob Anderson
TESTIMONY 11	Jerry Danni
TESTIMONY 12	Mike McClean
TESTIMONY 13	Trevor Dolby
TESTIMONY 14	Carlos Cieri
TESTIMONY 15	John Bailey

LETTER 1

United States Department of the Interior
GEOLOGICAL SURVEY
Water Resources Division
Federal Building, Room 428
301 South Park Avenue, Drawer 10076
Helena, Montana 59626-0076

November 5, 1985

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Reclamation Division
Montana Dept. of State Lands
1625 11th Avenue
Helena, Montana 59620

RECEIVED
NOV 0 8 1985
STATE LANDS

Dear Mr. Walther:

We have reviewed the draft Environmental Impact Statement for the Jardine Joint Venture Project. Our review was limited to the hydrologic considerations addressed in the report. As a result of our review, we have the following comments:

A 1. Page II-13, Table II-5--The listing of pH and conductivity together and of temperature and dissolved oxygen together as single parameters may be confusing to some readers.

B 2. Pages III-14 and III-15--The acronym TSS is referred to as "total suspended sediment" on page III-14 and as "total suspended solids" on page III-15. Consistent usage may help avoid confusion.

C 3. Pages II-17 and III-11--The calculations of ground-water velocity seem to be in error in that they do not account for effective porosity. U.S. Geological Survey Professional Paper 708 (p. 10-11) may be useful in revising the calculations. The revised calculations probably will indicate a ground-water velocity considerably larger than the value stated in the draft EIS.

We hope these comments will be helpful in preparing the final EIS. If we can be of further assistance, please call.

Sincerely,

Joe A. Moreland

Joe A. Moreland
District Chief

A Comment noted. Please see revised table II-5.

B The text has been edited to read "total suspended solids."

C DSL agrees. Assuming an effective porosity of 0.45 (USGS, 1967), the estimated rate of ground water flow through fractured rock would be about 5.6 x 10^{-5} feet/day, or less than 1 inch per year. The rate of ground water flow through Mineral Hill is much slower than through Bear Creek alluvium.

LETTER 2

THE GREAT BEAR FOUNDATION
P.O. Box 2699
Missoula, MT 59806
(406) 721-3009

November 19, 1985

RECEIVED
NOV 25 1985
STATE LANDS

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Montana Department of State Lands
Capitol Station
Helena, MT 59620

Re: Jardine Joint Venture Project

Dear Mr. Walther:

A Thank you for your letter of October 24, 1985 and the accompanying DEIS for the Jardine Joint Venture. Our comments will be restricted to the Joint Venture's clear potential for jeopardizing grizzly bears. Although the impacts that concern us could possibly be mitigated or counteracted by the involved agencies and companies, we see need for more such options than are displayed in the DEIS.

Although the affected area amounts to merely 67 acres, it could have a wide zone of influence on the grizzly bears of the Greater Yellowstone Ecosystem because these bears travel extensively for sometimes considerable distances. The widespread zone of influence would be largely due to more factors than modification of actual acreage, however.

Our major concerns are threefold.

B First, the Jardine Joint Venture is not the sole proposed new project in the Greater Yellowstone Ecosystem that could affect grizzly bears adversely. The absence of ecosystem-wide cumulative effects analysis is thus a serious barrier causing significant uncertainty as to how the Joint Venture would interact with other existing and proposed developments to have cumulative effects on a number of Greater Yellowstone Ecosystem grizzly bears.

C Second, displaced bears may merely run into problems elsewhere, particularly if other new developments elsewhere are added to existing developments elsewhere. While the DEIS does recognize that some grizzlies will be displaced, it does not adequately consider the potential "domino effect" that may result if bears displaced from this site cannot turn to suitably secluded, secure, effective habitat not already occupied by other grizzlies competing for such habitat.

D Third, bears not displaced, as the DEIS does recognize, may become habituated to the presence of people. But they may also be vulnerable to temptation presented by discarded human food, and may become food-conditioned as well as habituated. Such bears are implicated in grizzly-caused injury

Board of Directors
Arnold Bolle • William Callaghan • Craig Campbell • Lance Olsen • Frank Ponikvar • Phil Tawney • Mart Williams

A Comment noted, thank you.

B The proposed mine would contribute only a small proportion of ecosystem-wide impacts. In fact, the impacts of the mine on the entire Yellowstone ecosystem would be inconsequential. The federal Bear Management Unit surrounding the mine site was searched for proposed projects. These projects were limited to a subunit of the management unit (see Figure II-16). This subunit was subsequently used as a cumulative impact assessment area. Please see letter 26, response A.

C The revised text indicates that displaced bears could encounter competition or aggression from bears in surrounding areas. However, compared to cruising radii of bears, displacement distances would be small. These short distances would tend to limit conflicts. Furthermore, even without the mine, conflicts between roaming and resident bears would occur. The outcomes of competition and aggression cannot be predicted due to the large number of variables involved (that is, food availability, season, and age and sex of bears). Displacement would be reduced as bears habituate to mining activities.

D Mining would not cause substantial increases in discarded foods available to bears. As noted in the draft, bear-proof containers would be used in the permit area. The applicant has also committed to the timely removal of garbage. Recreation could slightly increase discarded foods.

LETTER 2

Mr. Walther
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November 19, 1985

and death to humans and, for that reason, are typically destroyed or sent to zoos. Methods to counteract this problem exist but could result in displacing these bears with effects described above; the habituation/displacement problem thus presents a management dilemma if the Jardine Joint Venture is permitted.

E Each of the three above concerns is all the more salient because the affected area receives high-density use by grizzlies, presumably by grizzlies from various points both near and far within the Greater Yellowstone Ecosystem. The Joint Venture could thus affect and jeopardize a number of bears and, therefore, could have significant adverse impact on a grizzly population that has been in decline. (We can see reason to believe the decline is not continuing today; grizzly populations do not readily rebound from decline and abundant evidence demonstrates decline of the GYE grizzly population.) Avoiding such impact on an already-vulnerable grizzly bear population will be imperative.

F Avoiding such impact will also be challenging and difficult if possible at all, because the situation is more complex than the above three problem-summaries suggest. For instance, other problems in the northern Yellowstone area include but are not limited to domestic sheep grazing proposed for the Meatrack-Carbonate area, proposed but vague and indefinite access plans in the West Gardiner area, a proposed vacation resort near West Yellowstone and undetermined road construction and timber removal plans. Even if each such proposal was not significant in its own right, the fact of multiple uncertainty creates indisputably significant uncertainty for grizzlies across the northern extent of Yellowstone and, indeed, throughout the Greater Yellowstone Ecosystem. It would be much easier to realistically assess and possibly deal productively with the problems presented by the Jardine Joint Venture if these other proposals were not in existence or if the overall atmosphere of uncertainty was cleared up; the present situation is one of hypothetical situation upon hypothetical situation, repeatedly, each with potential for adverse effect(s) on the grizzly.

Mitigation in such conditions may not suffice, since mitigated adversity is still adversity and multiple mitigated adversity can have a cumulative effect as devastating as a smaller number of unmitigated adversities. The habituation vs. displacement dilemma is of course compounded by this existence of multiple uncertainties and multiple potential adversities for the grizzly bear.

G We would like to see the Jardine Joint Venture analyzed via an ecosystem-wide Cumulative Effects Analysis. We would like to see it made explicit that a number of industries are competing with each other for access to the Greater Yellowstone Ecosystem, an ecosystem which is but one part of the mere 1 percent of the western United States acreage once occupied by the grizzly bear. This overall analysis is going to be essential to sound resource development in the grizzly's last fractions of its former ranges in the western United States.

However, only a small portion of the recreational increase would be related to the mine. The Forest Service would continue to require recreationists to handle and dispose of food properly. Significant additions to Jardine's population are not projected (see Chapter III-Sociology, Population Projections). Discarded food levels in Jardine, therefore, would be similar to baseline levels.

Your other comments are noted. Managing bears in proximity with humans will always be a challenge.

E The mine could adversely affect bears. However, as discussed in the draft, several unknown variables make definite predictions difficult. The revised text refers to Knight and Eberhardt's (1985) evaluation of the bear population trend.

F The Forest Service proposes to move the Ash Mountain sheep allotment to the Meat Rack-Carbonate area. The goal of this relocation is to reduce impacts to bears. Please see letter 22, response J. The new allotment would lie outside of the Hellroaring/Bear (Creek) Bear Management Unit. Neither the West Gardiner access area nor the West Yellowstone resort would be contained in this bear management unit. Undetermined road and timber plans, of course, cannot be addressed in the EIS. The draft addressed cumulative impacts using the best available methods. The cumulative effects analysis, as proposed by the IGBST, will eventually address ecosystem-wide impacts to bears.

G Please see, responses B and F and letter 26, response A.

LETTER 2

Mr. Walther
Page 3
November 19, 1985

H As per the Jardine Joint Venture itself, we are concerned that it not be "just another" problem for the grizzly if any opportunities exist for it to be part of the solution. We are in that regard concerned about the loss of 67 acres, and are even more concerned about the human traffic and presence that could create habituated, food-conditioned bears described in Herrero's 1985 book. We would welcome opportunity to evaluate ways for the Joint Venture to be part of the solution, if such opportunities exist and can be effected by the agencies and companies involved. However, we do not see such opportunities described and detailed in the DEIS.

I The Final Environmental Impact Statement will be unrealistic if it evaluates the Jardine Joint Venture out of context and will be superficial unless it describes in detail how the problems of displacement/habituation can be not merely "mitigated" but also counteracted and reversed.

J The major problems the Joint Venture would cause for grizzlies are summarized on pp. III-39 through III-42 of the DEIS, and are primarily problems of more people in grizzly habitat, causing additional displacement problems and mortality risks for the grizzly. Increased bear deaths due to traffic, increased recreationist use of grizzly habitat, increased risk of bear-human confrontation and other problems associated with increased human presence would be the major limiting factor for the grizzly and are thus a major limiting factor for and a major barrier to the Jardine Joint Venture.

K It is important to stress that the DEIS lists problems on pp. III-39 to III-42 (e.g., bears killed by traffic) that are not listed in "mitigating measures" described on pp. III-42 to III-4B. It is possible, however that the local public can accept speed limits in order to gain employment opportunity. It seems that slowing down is a practical way to favor grizzly survival and employment opportunity alike, and that instead of being a limiting factor for bears and jobs, traffic could be regulated to favor both.

L Simple traffic regulation could also reduce road kills of elk and deer, thereby reducing another limiting factor (for grizzlies) that currently stands in the way of the Joint Venture. It is also evident that simply slowing traffic will reduce human traffic-caused deaths, in addition to traffic-caused deaths of elk, deer and grizzlies.

M Put the bear-proof fence around the tailings pond from day one. Don't wait until bears die of poisoning.

N Increased recreationists' use of grizzly habitat would be a major and debilitating limiting factor for the grizzly bears, and is therefore a major limiting factor for the Joint Venture. You will want to devise, articulate and develop means for dealing with this factor so that it does become a limiting factor for grizzlies and the Joint Venture.

H Note that successful reclamation of the 67 acres is predicted in the EIS (Chapter III--Vegetation). Please see letter 2, response D. Mitigating measures were described in the draft EIS. The final EIS identifies those which the agencies would require and describes the applicant's proposals to reduce impacts. The Great Bear Foundation should contact the applicant regarding additional mitigations.

I The impacts of the mine are evaluated in the context of the assessment area (figure II-16 of the draft). The mitigations described in the final EIS follow Council on Environmental Quality guidelines (40 CFR 1502.14 and 1502.16). Mitigations are attempts to counteract impacts.

J We identified the factors you list as important issues. Each issue is discussed in the EIS. Please note, however, that many of the impacts would be only partially caused by mining. Furthermore, due to the many variables, some predictions cannot determine the magnitude or probability of impacts.

K The permitting agencies would require feasible mitigations for all major impacts. These mitigations are listed in the final EIS as is the applicant's traffic reduction plan. The Park County Commissioners would be responsible for determining speed limits on the Jardine Road. The Montana Department of Highways could reduce speed limits on segments of U.S. 89 if problems develop.

L The JJV has proposed an employee-transportation and traffic-control plan that would decrease traffic on the Jardine Road. The plan is described in Chapter I of the final EIS. Reducing speed limits on U.S. 89 is the responsibility of the Montana Department of Highways. (See also response K.)

M Please see letter 10, response B and letter 20, response JJ and the mitigation listed in the final EIS. Also note that most moisture would be removed from the tailings. The tailings would then be deposited in a large pile or dump.

N Gallatin National Forest would continue to manage recreation based on Grizzly Bear Standards and Guidelines (U.S. Forest Service, 1984). The IGBST's Cumulative Effects Analysis would provide additional management directives. Again, note that only a small portion of the recreational increase can be attributed to the applicant's proposal.

LETTER 2

Mr. Walther
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November 19, 1985

O Again, it is important to stress that not only the bears that have a stake in solving this matter, but also the Joint Venture, jobs, and the economy of Park County will be affected. You need to consider sensitive, responsive ways to control (with industry support and local economic leaders' support) the limiting factor of excessive recreationist access to grizzly habitat.

P In this vein, you will want to evaluate Forest Service plans such as access plans in the West Gardiner area. You will also want to evaluate specific areas for deployment of alternatives such as seasonal area closures, access by permit only, high-profile local education in camping safety practices such as the pack-it-in, pack-it-out philosophy and other ways to prevent recreationist use of grizzly habitat from becoming a limiting factor for the bear and, thereby, a limiting factor for the Joint Project. This matter is going to be particularly vital because, in effect, you want grizzlies to be displaced from the Joint Venture site, to prevent their habituation, and you need to therefore assure that grizzlies will indeed have security from further harassment and disturbance on alternative sites.

We support enlisting industry's active participation in mitigation/counteractive measures. Industry and the bear face common limiting factors that, unless resolved in favor of both, are a barrier for industry.

Q You should determine if industry will have legal rights to take disciplinary action - including termination action - in the case of employees convicted of harassing, disturbing or poaching grizzlies whether or not the offense is in on duty or off duty hours. This mitigation cannot be imposed on industry if it is not legal; perhaps it could be part of an employee contract for employment.

Perhaps industry could also sponsor an active employee-education program on grizzly bears. We believe such a program, if well-designed, would be helpful to the overall mitigation needed.

R Our point here is less to recommend specific actions that industry can take than to point out that industry can and should participate in solving limiting factors that affect bears and industry alike. We also stress that an array of solutions is mandatory and can, if well-designed and well-implemented, avoid adversarial legal proceedings while winning local support. In sum, what you must work for is a "success story" that not only mitigates but in many or all cases counteracts factors that limit the bear, industry, jobs and the economy of Park County.

S As presently described in the DEIS, permitting the Joint Venture amounts to opening Pandora's Box because so many factors remain uncertain. A worst-case scenario is therefore required until and/or unless these multiple significant uncertainties and their cumulative effects can be solved. As our remarks should illustrate, we generally accept an hypothesis that these matters are not insoluble, although we cannot, a priori, evaluate solutions that are as yet unstated and undetailed.

O Comment noted, thank you.

P Please see letter 2, response N. The West Gardiner area falls outside of the Bear Management Unit.

Q The applicant's revised plan commits the JJV to take disciplinary action against violators of wildlife laws (R.T. Agar, ACNC, pers. comm., January 22, 1986). This action would be added to state and federal penalties.

The applicant has a wildlife policy that includes posting wildlife regulations, regulating firearms, and discouraging wildlife harassment. Educating the residents of Park County about wildlife would remain the responsibility of the National Park Service, U.S. Forest Service, and the Montana Department of Fish, Wildlife and Parks.

R Comment noted, thank you.

S We reviewed relevant information and developed probable scenarios for the EIS. Variables and unknown factors are identified in the document.

Mr. Walther
Page 5
November 19, 1985

LETTER 2

The Great Bear Foundation is a non profit, tax exempt corporation established in 1982 for conservation of wild bears. Its work is supported by tax-deductible gifts from individuals, businesses, and by grants from organizations and foundations and by sales of t-shirts, art, books, etc. The Great Bear Foundation publishes a serial publication, BEAR NEWS; gives high-quality books about grizzlies to local public libraries, school libraries and selected individuals in grizzly country; has begun a new program reimbursing ranchers for economic loss caused when grizzlies kill livestock on privately owned ranchlands, and maintains communications with agencies, industries, conservation groups and national print and broadcast media. To date, Great Bear Foundation efforts have emphasized non-adversarial problem-solving that meets the requirements of wild bear conservation.

Thank you for this opportunity to comment on the DEIS for the Jardine Joint Venture. We do urge you to pursue opportunities that may exist for dealing with the limiting factors and significant uncertainties that are of considerable concern to us.

Sincerely,

Lance Olsen
President

sw

cc: Bob Anderson
Tom France
Whitney Tilt
Jim Posewitz
Jim Curtis

LETTER 3

Rt. 2, Box 1124
King George, VA 22485
November 30, 1985

RECEIVED
DEC 04 1985
STATE LANDS

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Montana Dept. of State Lands
Capitol Station
Helena, MT 59620

Dear Mr. Walther:

I have just recently seen the proposals for vehicular access into the Jardine Joint Venture Mining Project, and as a frequent visitor to the Jardine area I feel the need to comment on the road proposals.

Of the three possible routes submitted (one from HMC/ACNC, two from State Of Montana), I find the greatest credibility in Montana's Alternative #1. This alternative would allow the necessary economic growth and development to coincide with the aesthetics of the Jardine Community and the preservation of the historic area. It would allow the existing community to remain intact and still facilitate easy access to the mining offices and operation. As proposed, Alternative #1 also has strength in the fact that it would provide a more direct, and apparently safer, route for the heavy equipment, as well as minimizing environmental impact by travelling through an area already disrupted by the spoils ponds.

For the above reasons, Alternative #1 is by far the best of the proposed options, but if it proves unfeasible, then Alternative #2 would still be better than HMC/ACNC's proposal. Alt. #2's strength lies in the fact that it would not disrupt the historic section of Jardine, and still provide a safe ingress/egress route for heavy trucks.

Thank you for the opportunity to comment on these proposals, and for the consideration these proposals are getting. Jardine is an area of both sentimental and emotional significance not only to myself but many family and friends. I'm sure the best decision will be made.

Sincerely,

Bill Almond

William K. Almond

After the publication of the draft EIS, the JJV has proposed to use the exiting bridge and road to access the mine area. This change would avoid having to remove the five historic structures in addition to avoiding construction of a second bridge and new road. Because the two mine access road alternatives evaluated in the draft EIS would offer no environmental advantage to the applicant's new proposed mine access road, the two alternatives are not considered in the final EIS (see Chapter I).

LETTER 4

This letter is a typed reproduction of a handwritten,
signed letter that was received by the Department.
The letter was typed for ease of reading after publication.

Dear Sir:

I think the (ACNC) company would be a good asset to Park County and the State of Montana.

They take care of their dump and pump the sludge back in the mine. Everything should come back to normal.

As far as poaching or antler collecting, it shouldn't be any more or less than it is now.

The elk will migrate almost as usual. They might make a detour for a year or so, then they will go on as usual.

The grizzly bear might move around the mine for awhile. It won't bother them very long. The Park Service has dumped grizzlies out at the head of every creek up and down the Yellowstone. There have been grizzlies show up where they have never been before.

The mine won't bother the wildlife.

They save the topsoil to put back when they are done.

This is a real good deal for everyone.

I am for the mine.

Gerald B. Bowles

Comments noted, thank you. Some analyses offered in the draft differ from your assessment.

LETTER 5

Wildlife Management Institute
Suite 725, 1101 14th Street, N.W., Washington, D.C. 20005 • 202/371-1808

DANIEL A. POOLE
President
L. R. JAHN
Vice President
L. L. WILLIAMSON
Secretary
WESLEY M. DIXON Jr.
Board Chairman

RECEIVED
NOV 25 1985

November 19, 1985

RECEIVED
DEC 13 1985
STATE LANDS

Forest Supervisor
Galatin National Forest
Federal Building
Bozeman, Montana 59717

Dear Sir:

The Wildlife Management Institute is pleased to comment on JARDINE JOINT VENTURE PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT.

We would prefer that this mine development, mill, and tailings area not be developed at the location near Gardenier, Montana. However under the law it probably will be developed.

We, therefore, prefer the Agencies' Alternative A for the county road, and Alternative One to the mine access road.

These remarks have been coordinated with William B. Morse, the Institute's Western Representative.

Sincerely,

Daniel A. Poole

Daniel A. Poole
President

DAP:slh

DEDICATED TO WILDLIFE SINCE 1911

Comment noted, thank you. Note that the applicant, since publication of the draft EIS, has proposed a new mine access road and an employee-transportation and traffic-reduction plan to reduce traffic on the Jardine Road. The applicant's new proposals are preferred to the alternatives analyzed in the draft EIS (see Chapter I--Summary, Chapter III--Summary and Chapter IV--Summary of the final EIS).

LETTER 6

DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

TED SCHWINDEN, GOVERNOR
COGSWELL BUILDING

STATE OF MONTANA

HELENA, MONTANA 59620

RECEIVED
DEC 12 1985
STATE LANDS

December 10, 1985

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Department of State Lands
Capitol Station
Helena, Montana 59620

Dear Kit,

Thank you for the opportunity to review and comment on the Jardine Joint Venture Project Environmental Impact Statement. Enclosed are our comments for your consideration in the final E.I.S.

Your Department, the Gallatin National Forest, the mining companies and their respective contractors have done an excellent job in evaluating this project. Overall, I believe the E.I.S. addresses the project in a very professional manner.

If we can be of further assistance or if you have questions or comments, please contact me at 444-2406.

Very truly yours,

Larry L. Brown
Hydrologist
Water Quality Bureau
Environmental Sciences Division

LLB:qr/0002N

Enclosure

LETTER 6

Comments

A 1. Page II-11 and Page III-6: Sediment Load
Page III-14 and 15: Aquatics

Imbeddedness of fine sediments is a major concern. An increase in Total Suspended Sediment (TSS) for one year, even in a high gradient, cascading stream such as Bear Creek, could have adverse impacts on aquatic life and fish habitat. Sediment particles may settle in pools, plug interstitial spaces and armor the streambed.

The predicted (calculated) increase in sediment load to Bear Creek resulting from construction of roads and facilities may violate state water quality standards unless adequate soil and water conservation practices are applied (ref. 16.20.603(11) A.R.M.). In order to evaluate the possibility of state water quality standards being violated, a detailed sediment control plan for control of sediment during and following construction of this facility is needed.

B 2. Page III-8: Control of Dissolved Metals and Cyanide

A pH of 9.5 or higher is generally needed to precipitate heavy metals and bind cyanide in a stable chemical complex. The ultimate pH of the tailings pile should be considered in terms of the necessity to add fly ash or a liming agent to the tails to control development (long-term) of an acidic condition.

C 3. Page III-9: Slurry Pipeline Containment

Specific description and design of the containment trench and holding pond(s) for tailings pipelines should be included in the EIS. These facilities are needed to contain fluids and slurry spills if a break in the line(s) should occur. Of particular concern are the design and size of the containment trench for slurry to the tailings pond and the pipeline(s) transporting backfill to the mine stopes.

D 4. Page I-8: Potable Water and Septic System

The proposed disposal of sewage effluent from a septic tank into a drainfield located approximately 100 feet from Bear Creek may not provide adequate treatment for phosphorus (ref. 16.20.631(5) Surface Water Quality Standards, A.R.M.). Algal communities may increase in Lower Bear Creek as a result of increased nutrient loading. Increased algal growth could reduce the dissolved oxygen level in the interstices of spawning gravels thus affecting fish egg development. This has not been addressed in the EIS and this omission should be rectified or the septic effluent should be routed into the mine water circuit.

E 5. Monitoring for presumptive cyanide at Bear Creek Stations 008 and 010 daily is expensive, time-consuming and not quantifiable. Quarterly sampling for amenable and total cyanide at Bear Creek Stations 008 and 010, particularly to establish an adequate background concentration, should be sufficient.

A Actual concentrations of total suspended solids (TSS) would be difficult, if not impossible, to predict accurately. This point is stressed on page III-6 of the draft EIS, which states in part:

> "Predictions presented in table III-1 are intended to indicate trends or to compare management alternatives. To a lesser extent, they may provide quantified estimates of sediment yield... Actual concentrations would depend largely on prevailing weather conditions as well as the effectiveness of the erosion control practices employed."

The predictions, therefore, illustrate a trend, with the most significant impact occurring during construction and earth moving, as would be expected. Predictions presented in table III-1 should not be used at face value, and cannot be used to determine violations of Montana water quality laws.

In fact, if reasonable land, soil, and water conservation practices have been employed, increases in sediment loading to Bear Creek which are associated with mining activities would not technically violate Department of Health water quality standards (Montana Department of Health and Environmental Sciences, Water Quality Bureau, Administrative Rules - ARM Title 16, Chapter 20, Sub-Chapter 6).

In order to evaluate whether reasonable land, soil, and water conservation practices have been employed, a list of the erosion-control measures which would be used at the facilities area, the minesite, the impoundment area, and for all roads, including the conditions under which each control measure would be implemented, is included as Appendix 14.

B We agree. The pH of the tailings throughout the mill process would be kept high to prevent formation of hydrogen cyanide. Once the tailings reach the impoundment, several processes would occur that would reduce cyanide concentrations or convert cyanide molecules into nontoxic substances. (Please see the discussion in Chapter III--Soils, Tailings Dump of the EIS.) Because of the design of the tailings facility, any cyanide remaining in the impoundment would not reach ground or surface waters.

C Appendix 21 provides details regarding the proposed containment trenches and holding ponds. The location of the holding ponds are presented in revised Figure I-2. Containment ponds have been located at the base of the hillside between the mine and the mill, and at the mill. The containment ponds would be sized with sufficient capacity to completely contain a spill equal to the volume of pipeline above the pond.

D The assertion that the proposed septic tank system would not provide adequate treatment for phosphorus remains unsubstantiated and is unsupported by scientific evidence or fact.

A simple mass balance calculation under worst-case conditions indicates phosphorus would not be a problem, regardless of the location of the septic tank/drainfield location:

LETTER 6

An extensive vadose zone monitoring system is recommended around and under the return water pond, sludge pond and tailings pile. Presumptive cyanide analyses could be performed on fluids or leachates that are detected in these systems. However, if fluids or a leachate are detected, the warning that the liner is leaking should trigger emergency reaction for containment of a leak and rehabilitation of the liner. These monitoring systems should be checked daily for fluid or leachate.

The existing "monitoring" wells should be sampled quarterly for amenable and total cyanide.

Total containment of cyanide compounds in the milling process is necessary to prevent spills from reaching Bear Creek or groundwater. Containment facilities, including monitoring equipment, should be installed as needed to adequately protect the resource.

The Department of Health and Environmental Sciences, the Department of State Lands, and the Joint Venture Companies should review and revise, if necessary, the monitoring program yearly.

F 6. Page III-9: Water Quality Monitoring-Drainfield

Monitoring fecal coliform bacteria only below the proposed drainfield is not feasible due to the likelihood that background bacteria levels from other sources are also high. Sampling for fecal coliform bacteria, phosphorus, kjeldahl nitrate and ammonia should be included at both an upstream and downstream site from the drainfield. Holding time to maintain quality assurance can be overcome by performing the analyses at the assay lab on site.

An alternative to the drainfield as the receiver of septic effluent should be considered to reduce nutrient loading into Bear Creek.

LLB:gr/0017N

Phosphorus Load from Proposed Disposal System (EPA, 1982)

9 mg/l x 3.788 L/gal x 3,850 gal/day = 131,254 mg/day

Volume of Receiving Water at Low Flow

$$5\ \frac{\text{ft}^3}{\text{sec}} \times 28.32\ \frac{\text{L}}{\text{ft}^3} \times 86{,}400\ \frac{\text{sec}}{\text{day}} = 12{,}234{,}240\ \text{l/day}$$

Increase in Phosphorus (Worst Case)

$$\frac{131{,}254\ \text{mg/day}}{12{,}234{,}240\ \text{L/day}} = 0.01\ \text{mg/l}$$

Baseline Phosphorus concentration = <0.01 mg/L
State Standard = 0.1 mg/L
Detection Limit (EPA 365.1) = 0.1 mg/L

The predicted increase would therefore be ten times less than the laboratory detection limit and state standard.

In addition, the applicant proposes to relocate the drainfield to a site approximately 500 feet from Bear Creek. The new location is shown on revised Figure I-2.

E Please note that "Daily monitoring for presumptive cyanide at Bear Creek Station 008 and 010" was added to the monitoring plan at the suggestion of the Water Quality Bureau (Larry Brown, MDHES, pers. comm., May 10, 1984). Comments regarding other facets of hydrologic monitoring are noted.

Appendix 15 presents the details of the updated hydrologic monitoring plan.

F Comments noted. See response D for a discussion of the location of the alternative sewage disposal system. Appendix 15 presents the details of the updated hydrologic monitoring plan.

LETTER 7

PARK COUNTY COMMISSIONERS

414 E. Callender
Livingston, Montana 59047
406-222-6120

December 11, 1985

RECEIVED
DEC 16 1985
STATE LANDS

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Reclamation Bureau
Department of State Lands
1625 11th Avenue
Helena, Montana 59620

Dear Mr. Walther:

The only comment we would like to make on the Jardine Joint Venture Draft Environmental Impact Statement pertains to the road between Gardiner and Jardine. We prefer the applicant's proposed road "P" to either Alternative "A" or "B" as identified in the DEIS.

Alternative "P" (upgrading the existing Z-Hill road through Gardiner) is the alternative agreed upon by Joint Venture Officials and County Officials during the "Economic Impact Plan" process. The resulting Economic Impact Plan was approved by the State's Hard Rock Impact Board in February, 1985.

Alternative "P" was agreed upon because of a number of geologic, ecological, and construction problems identified with Alternative "A" and "B". These problems were discussed in a document entitled "Preliminary Jardine Road Evaluation" (December 1984) prepared by Mr. Michel E. McLean, Project Engineer for the Jardine Joint Venture Project (copy enclosed).

While recognizing that Mr. McLean is not a highway construction engineer, the "Preliminary Road Evaluation" provided us with enough evidence that it was in everybody's best interest (the County's, the residents of the Gardiner-Jardine area, and the company's) to upgrade the existing road rather than develop a new road across unstable and highly visible terrain. We still feel this is the best alternative.

Furthermore, this decision was not made until we had consulted with Mr. Don Fallang of the Montana Department of Highways. After Mr. Fallang made an on-site tour of Alternatives "A", "B", and "P" with us on December 6, 1984, he indicated that the Z-Hill Road could be upgraded to ". . . produce a good serviceable road for the needs of the public . . ." (see attached letter).

Comment noted, thank you.

LETTER 7

Mr. Kit Walther
12/11/85
Page 2

Nevertheless, we recognize the concerns expressed at the public hearing by residents living along the lower stretch of Z-Hill, and intend to solicit ideas and suggestions directly from those residents once professional engineers are retained to do detailed design work on the road.

We are confident that with input from the people who live along the road, and with professional engineering assistance, the Z-Hill Road can be upgraded to accommodate the maximum projected increase in traffic over what it currently experiences.

Thank you for the opportunity to comment. If you have any questions, please get in touch.

Sincerely,

Cliff Olson

Cliff Olson, Chairman

Ken Spalding

Carlo Cieri

CO/js

Enclosure

LETTER 7

PRELIMINARY
JARDINE ROAD EVALUATION
DECEMBER 1984

MICHAEL E. McLEAN
PROJECT ENGINEER
JARDINE PROJECT

LETTER 7

GENERAL

This preliminary evaluation has been prepared in order to satisfy certain questions regarding the existing Jardine Road. These questions were raised at a joint meeting between members of the Park County Commission, representatives of the State of Montana Highway Department, the Park County Planner, and representatives of the Jardine Joint Venture.

This evaluation is intended to serve as a prelude to a formal engineering study which will be undertaken at an appropriate time prior to advanced project construction.

A general understanding has been reached between the aforementioned parties that the upgrading of the existng Jardine Road is preferable to relocation as suggested in the Jardine Joint Venture application for an operating permit.

The preliminary evaluation consists of:

1) a brief discussion of problems with road relocation;
2) a road log from Gardiner to Jardine noting areas of possible improvement;
3) profile data and brief discussion of the " Z " hill;
4) typical proposed cross section for improved road.

LETTER 7

ROAD RELOCATION

The original text of the Jardine Joint Venture Operating Plan listed three alternatives for addressing the Jardine Road. At that time, relocation of the lower part of the road was proposed due to projected heavy use by concentrate trucks hauling from the Jardine mill facility to U. S. 89.

Revisions in ore treatment plans have eliminated this consideration for road relocation.

Other factors influencing dismissal of road relocation include:

1) negative environmental impact on existing animal travel routes, and high visibility from Gardiner--Yellowstone Park area.
2) geologic conditions through proposed route (multiple shears, faults, and basalt flows) which would result in poor construction conditions and high maintenance costs for Park County;
3) questionable grade modification benefits resulting from changing the the present one mile at 8% to + 2½ miles at ±6%.

LETTER 7

JARDINE TO GARDINER ROAD LOG

The following road log is presented for general reference. Problem areas are noted with possible improvements. Road measurements were made as indicated. Blasting required would be limited and would not restrict traffic for long periods of time or be subject to radio/static electricity hazards. Improvements would be detailed, where required, in the formal engineering study as noted earlier.

MILE	ROAD WIDTH (FT.)	REMARKS
0.00	----	West end of Bear Creek bridge at Jardine
0.85	24.0	First residential access entering Jardine. Starting point for dust control or paving.
1.00	24.0	low visibility curve, guardrail advisable for 0.7 miles.
1.40	----	low visibility corner with outcrops requiring some blasting.
1.45	----	end outcrop area
1.65	24.0	continue guardrail
1.70	----	end guardrail
1.75	----	wide turnout on east side of road--valley overlook
2.00	26.0	----
2.30	----	start low visibility curve
2.35	----	turnout--east side, low visibility, popular hunter/sightseer stop
2.40	----	outcrops, end low visibility curve
2.50	----	entrance to water holding pond
2.85	----	turnout--east side, start of poor drainage section
3.00	30.0	intersection with Eagle Creek road
3.10	----	low visibility curves continued poor drainage
3.25	----	low visibility corner
3.40	----	access road to Eagle Creek Recreation site
3.45	----	end poor drainage section
3.60	----	low visibility corner (.05 mile)

LETTER 7

JARDINE TO GARDINER ROAD LOG, continued, page 2

MILE	ROAD WIDTH (FT.)	REMARKS
3.90	----	Blanding Station road, poor visibility corner
4.00	24.0	----
4.10	----	residential access road
4.25	29.0	top of "Z" Hill
4.70	----	Little Trail Creek road
4.80	34.0	entrance to lower travertine quarry
5.0	25.0	spring above road with poor drainage, advise tiles and culvert; possible end of pavement
5.1	24.0	overflow culvert from Gardiner water supply; last Gardiner residence below road
5.30	----	poor visibility--point of rock for 0.05 mile
5.50	----	Rocky Mountain Camp entrance, possible fill area on west side of road
5.60	----	junction with U. S. 89 in Gardiner, commence paving for dust control

LETTER 7

"Z" HILL PROFILE

One of the major Jardine Road issues deals with the grade of "Z" Hill. A profile was made which indicates the overall grade is 8.08%. The steepest portion of the grade exists between the springs and Gardiner's water supply overflow culvert on the lower section of raod. The grade through this area is 10.55% for 379.39 feet.

Minor alteration of the existing right of way between the lower travertine quarry and Little Trail Creek Road should help in lessening the overall grade, as well as, improving turning radii and drainage.

Stadia survey data and notes appear on the following page.

LETTER 7

" Z " HILL STADIA SURVEY DATA

STADIA PT.	F.S. PT.	HORIZ. DIST. (FT.)	VERT. DIST. (FT.)	GRADE %
Z1	RM1	187.80	13.54	7.21
Z1	RM2	98.52	3.84	3.90
Z1	Z2	161.63	10.96	6.78
Z2	Z3	532.53	32.38	6.08
Z3	Z4	387.89	20.75	5.35
Z4	Z5	122.08	8.68	7.11
Z5	Z6	147.89	12.79	8.65
Z6	Z7	883.62	75.11	8.50
Z7	Z8	856.83	78.40	9.15
Z8	Z9	162.64	7.68	4.72
Z9	Z10	74.14	6.43	8.67
Z10	Z11	322.40	26.05	8.08
Z11	Z12	383.48	34.01	8.87
Z12	Z13	377.30	39.81	10.55
Z13	Z14	654.13	61.95	9.47

OVERALL GRADE = $\frac{432.38 \text{ ft.}}{5352.89 \text{ ft.}} = 8.08\ \%$

NOTES

Survey work was done 12/17/84 using a WILD T-1 Theodolite and WILD stadia rod.

Survey by: F. Bent and M. McLean

Point Z1 represents the top of 'Z" hill. USFS monuments were surveyed to provide data for resection of Z1 if needed.

Point Z14 represents the approximate bottom of the hill. This point is adjacent to Mountain Bell junction box labeled 5/50.

The steepest section of road occurs between the spring area and the culvert draining the water supply tank overflow (379.39 ft. @ 10.55%).

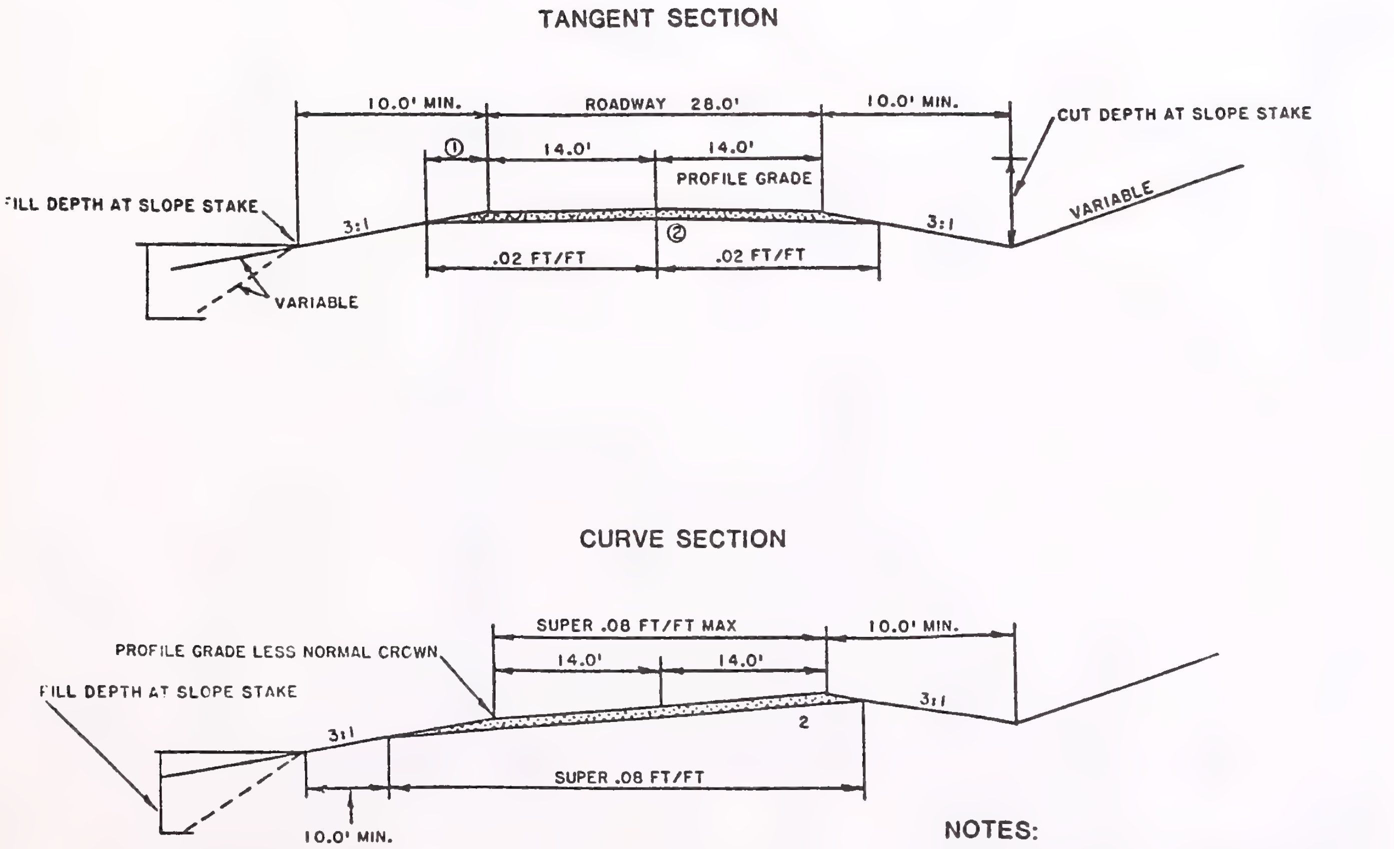
LETTER 7

PUBLIC ROAD CROSS SECTION

The cross section on the following page is taken from the Jardine Joint Venture Operating Plan. This is a generalized view.

Actual construction will be based on detailed engineering analysis (as previously discussed) and modifications deemed necessary by county/state government.

LETTER 7



NOTES:

① - VARIES ACCORDING TO SURFACING THICKNESS

② - 6" OF 1 1/2" MINUS BASE COURSE GRAVEL
PLUS 3" OF 3/4" MINUS TOP SURFACING

ROAD CROSS SECTION
PUBLIC ROADS

LETTER 7

DEPARTMENT OF HIGHWAYS

[illegible]
2701 PROSPECT
STATE OF MONTANA
HELENA MONTANA 59620

December 13, 1984

Park County Commissioners
Park County Courthouse
Livingston, MT 59047

Dear Commissioners:

The following recommendations are made for your use in pursuing improvements to the Gardiner-Jardine Road.

1. Improve Horizontal Curvature where possible.
2. Improve some of the vertical alignment where stopping distance is not adequate for the speeds to be expected by the public.
3. Remove brush and vegetation along backslopes for better sight distances on curves.
4. Do some slope work for improved visibility and snow storage.
5. Improve drainage.
6. Install guardrail on the most critical highfill areas and on some of the curves.
7. Regrade and improve the superelevation on all horizontal curves.
8. Maintain gravel surfacing on all of the road except through Gardiner and Jardine. When new gravel surfacing is put on, there should be adequate binder in the gravel to hold it together for reduced maintenance and smoother road conditions.
9. Pave those areas through Gardiner and Jardine where dust conditions could be a problem.
10. Minimum 24' wide Top Running Surface with turnouts spaced at convenient locations throughout the length.

The above items of work should produce a good serviceable road for the needs of the public at minimum cost providing adequate signing and guardrail are incorporated into the improvement.

LETTER 7

Park County Commissioners
December 13, 1984
Page 2

Thank you for seeking our comments and feel free to contact either Hank Butzlaff at 444-6113 or myself at 444-6110 if you have further questions.

Sincerely,

Don Fallang, Supervisor
Secondary Roads Section

DF:jm:2Ad

cc: Hank Butzlaff
File 532

LETTER 8

RECEIVED
DEC 13 1985
STATE LANDS

RECEIVED
Gardiner R.D.
2 '85
Info Action
D.R.
RES. ASST
RES. ASST
F.M.O.
RGE CON
B.M.A.
OTHER
OTHER

2107 Grand Avenue
Butte, Montana 59701
November 30, 1985

Mr. Larry Lewis, District Ranger
Gardiner Ranger District
P. O. Box 5
Gardiner, Montana 59030

Dear Mr. Lewis:

Weather permitting, we will have a representative at the public hearing on December 3rd. However, if we are unable to attend, we would appreciate having our comments entered in the record of the meeting.

We have reviewed the findings contained in the draft of the Environmental Impact Statement and we sincerely believe that the pluses far outweigh the minuses in regard to granting the permit for the Jardine Joint Venture Project.

We feel that Homestake Mining Company and American Copper and Nickel Company have anticipated and addressed the negative findings contained in the draft and have made provision to correct wherever possible the complaints which were presented.

It would appear that air and water pollution would be minimal, that the additional traffic could and would be handled in a satisfactory manner and that there will be reclamation of the land during and at the conclusion of the project.

We believe that the financial benefits to both Park County and the State of Montana would help to alleviate the problems which would arise if the Burlington-Northern Railroad does follow through with the present plan with regard to the Livingston operation.

We trust that no new substantial issues will be raised at this meeting and that the draft statement will stand in its present form, which will enable the permits to be issued at an early date.

Very truly yours,

Board of Directors
Crevasse Mountain Mining Company

Barbara Kautzman

By Mrs. Harold A. Kautzman
Secretary-Treasurer

Comment noted, thank you.

LETTER 9

State Historic Preservation Office
Montana Historical Society
Mailing Address: 225 North Roberts • Helena, MT 59620-9990
Office Address: 102 Broadway • Helena, MT • (406) 444-7715

December 12, 1985

Kit Walther, Chief
Environmental Analysis Bureau
Reclamation Division
Montana Department of State Lands
Helena, MT 59620

Re: Jardine Joint Venture Project
Draft Environmental Impact Statement

Dear Kit:

Thanks for sending over a copy of the document identified above. I continue to find no record that we received a copy during your regular mailing. I have a technical comment first, and then a larger, primary concern regarding treatment of cultural resources in project planning.

A On IN 8, the statement that the SHPO seeks determinations of National Register eligibility from the Keeper of the Register is not correct. Federal law and regulations (36CFR63 and 36CFR800) make that the responsibility of the involved federal agency, the Forest Service in this instance. We provide them with our recommendations regarding site value. They must then send that with other materials to the National Park Service, Register office. The same regulations then require the Forest Service to seek the comments of the Advisory Council on Historic Preservation regarding the project's effect on resources eligible for listing in the Register. Our legal responsibility is again to provide the Forest Service with our recommendations, prior to their request for comments from the Council. Often, by this stage of project planning, the federal agency has sought the Keeper's comments on site eligibility. That seems especially important in this case because the size of the eligible resource is in question.

B More important, I do not find the treatment of cultural resources in the document complete or adequate for their nature and the nature of impacts occurring. First, as the attached copy of our March 11, 1985, letter to you indicates, we recommended that areas outside those considered by HRA as eligible for the Register be recognized as having historic value and considered in project planning. For the purpose of state planning documents, none of us legally has to focus solely on what is and what is not eligible for listing in the Register. EIS documents should likely describe those other project areas that have potential for significance as we have outlined them. Or, the Forest Service should seek a formal reading of eligibility from the Keeper if they believe that a definitive answer to that issue would assist in project planning.

C Apart from that issue, the presentation of information on the primary standing

A The site occupies private land. The Forest Service level of involvement in the permitting process is limited to issuing the applicant a special-use permit for a portion of the tailings disposal area.

B The analysis in the EIS focuses on cultural resources that could be affected by the project regardless of their potential eligibility for listing on the National Register. Historic and archaeological sites in areas other than those evaluated in the EIS would not be directly affected by the project. Therefore, discussion of their contribution to the history of the area is not included in the EIS. HRA's report, which was used as the primary source document for the EIS, evaluates these other sites. The reader should refer to HRA's report if other information is desired.

LETTER 9

Walther
December 12, 1985
Page 2

historic buildings in Jardine significantly misrepresents the resources that are there and the impact to them. Within the historic district proposed by HRA, they have identified 40 historic buildings which contribute to the significance of that district. Those identified as "significant" are buildings which might qualify for listing in the Register by themselves. The label "contributing" applied to the others or the use of the term "poor" for condition for others in no way diminishes their historic value or the clear contribution of those buildings to larger entity that exists there--the historic district. On a comparative basis, and as recognized by several sequences of evaluation, the collection of buildings at Jardine, especially at the western end of the area, is among the most intact in Montana for a mining/mill complex of its original date and construction. So, while the buildings are not a condition that would permit immediate occupancy, their structural integrity does not diminish their ability to illustrate historic use, arrangement, and procedures.

Against that backdrop, I find the discussion of impact to them in Chapter III to understate significantly the results of Homestake's proposal. Of the 40 structures, which all of us agree contribute to the value of the historic district, 29 will be lost. Two thirds of the physical structures including the most visible and historically significant in terms of use will be lost. In addition to the loss of 29 out of 40 structures within the district all of which comprise its value the proposal involves the addition of a number of new buildings, parking lots, and construction features none of which are likely to be compatible with historic appearances and all of which will interfere with an understanding of historic mining activities. Hence, at the conclusion of the process, as now planned by Homestake, the entity that now clearly exists as a historic district will be lost.

D Nothing in state or federal law precludes a project such as this from being permitted with that rate of loss. However, the extent of loss to a resource widely considered of historic significance in Montana warrants thorough examination of design alternatives that reduce significantly the impacts to the historic district and other historic features. The discussion regarding alternatives to the mine access road appears to focus well on the extent of loss just that road would create and makes a strong case for a less impacting alternative. I strongly urge that the EIS document discuss other design alternatives in construction of the project that would substantially reduce the loss of historic materials and appearances elsewhere in the project area. It should treat the now anticipated loss of the Jardine Historic District much more directly in Chapter V, Denial of the Permit and Chapter III, Impacts of the Proposed Project. It should provide maps which illustrate loss and new construction. In short, given the extent of loss anticipated, I find it inappropriate to treat as a foregone conclusion the loss of a substantial portion of the historic district and then move on to a sequence of possible mitigating measures. We should, instead, begin here by looking for alternatives to that loss. (We would note as an aside to Chapter V, Denial of Permit, that if the permit is not granted, the entire historic district comprised of 40 contributing structures, not 21, would survive.)

C The agencies concur. Table II-47 is not to be interpreted that only structures and features considered eligible for listing on the National Register or that are in good (or better) condition have historic value.

The number of structures that would be destroyed by the project would be less than first proposed. After the publication of the DEIS, the JJV revised its mine access plan, rerouting the access road to avoid structures 62-65, 67, 68, and 72 (see Chapter I). These structures would remain intact. In addition, the JJV would remove and store those features which are not fixed in place, such as the wooden sluice box (feature 52), the wooden fly wheel (feature 61), and the wooden cyanide vats (structure 61) that would otherwise be affected by construction of the mill and laboratory. Development of the new mine portal would remove six structures. These structures must be removed to allow for development of the new portal. The fate of the old arsenic mill, which is thought to be heavily impregnated with arsenic, would be determined by results of chemical sampling of the structure. The JJV would leave the structure standing if chemical analyses demonstrate that the structure is not a health hazard. The structure would be demolished as proposed if analyses demonstrate it to be a health hazard as assumed in the draft EIS.

D There are no reasonable alternatives that would save the structures that would be destroyed by development of the new portal. The mill site is topographically suited and provides the least haul distance from the production portal.

LETTER 9

Walther
December 12, 1985
Page 3

Please call if you have questions. Thanks again for checking to see whether we had gotten a copy for comment.

Sincerely,

Marcella Sherfy

Marcella Sherfy
State Historic Preservation Officer

Enclosures

File: Comp/DSL/Homestake

LETTER 9

MONTANA HISTORICAL SOCIETY
HISTORIC PRESERVATION OFFICE
225 NORTH ROBERTS STREET • (406) 444-4584 • HELENA, MONTANA 59620
444-7715

March 11, 1985

Terry Grotbo, Bureau Chief
Hardrock Bureau
Reclamation Division
Department of State Lands
1625 Eleventh Avenue
Helena, MT 59620

RE: Homestake Mining
Cultural Resource in and around Jardine

Dear Terry:

We have been glad for this opportunity to review the additional material developed for Homestake by Historical Research Associates (HRA), Missoula. This was our first chance, also to review anticipated impacts to the resources of Jardine. We believe that the additional research and synthesis completed by HRA was a needed addition to the baseline material on Jardine first developed several years ago. We believe that it gives us the basis for fairly complete comments to you for permit review and EIS development. Our perception of what constitutes resources eligible for listing in the National Register of Historic Places differs from HRA's However, given our understanding of impacts, we do not believe that the difference requires resolution. Let me outline out thoughts and recommendations for you:

1. We believe that the proposed project area for the Homestake project overlays a collection of historic resources that qualify for listing in the National Register of Historic Places as a district.

2. We believe that larger boundaries for such a historic district than those proposed by HRA can be justified using National Register criteria.

3. However, within larger boundaries, we find that qualities which recommend inclusion of those resources in a district differ from area to area. The portion of Jardine recommended by HRA as a discrete district contains the greatest concentration of standing structures, structures which predominately represent the second phase of development in Jardine and reflect again predominately (but not wholly) industrial of mine management activities. Hence, that portion of Jardine is significant for its associative, architectural/engineering, and information values (Register criteria a, c, and d.) Our office recommends that the remaining houses west of Bear Creek, remnants of the commercial, housing, and first industrial area south of HRA's proposed boundary, and perhaps Mineral Hill resources be considered also having the qualities needed for listing, as an expanded district, in the National Register. Those areas all possess some architectural and historical value, perhaps most the housing area west of Bear Creek. HRA does not disagree strongly

LETTER 9

with our recommendation regarding these cabins. However, the southern commercial/industrial/residential area would appear to be important primarily for its potential to yield information about industrial processes, lifestyles and income levels in Jardine. Neither HRA's information nor GCM's provides detailed information on the potential for subsurface remains in the areas where Blankenship demolished buildings. However, we find that survival of a few standing structures, the likelihood of some foundation, dump, privy, and mining remains appears high enough to identify southern areas as significant for potential information values (criterion d). We believe that HRA recognizes the potential for some information value in the southern commercial/residential/industrial area and recognizes the fact that that area provides--however flawed due to demolition--a look at remnants from Jardine's first era of mining activity. They do not believe the level of significance warrants treatment of that area as contributing to a Register district. In short, I think we agree on qualities of historic resources in that area, but not on the relative value of those qualities. HRA has not recommended Mineral Hill for inclusion within a district. They note that the survival rate for resources in that area is low and that it is removed visually from the rest of the town and mill complex. We find that justification for including that area within a district can be based on its ability to provide information on the mining process itself and transportation of minerals to the mill complex. However, we again believe that the difference may not warrant resolution since impact does not appear likely in the Mineral Hill area.

If you would like to sit down with us with HRA's map, we can provide you with a clearer delineation of areas that appear to have potential for inclusion within a Register district than we can do with words.

4. For the purpose of your review and EIS writing, we believe that it is possible to describe the fact that Jardine contains a core of buildings and remains which retain greatest integrity and warrant greatest care in construction. They fall within the boundaries HRA proposed for a district. Additional historic buildings, remains, and foundations surrounding that area contribute to our understanding of the town and warrant some consideration in project planning--tailored to the nature of the values represented. The eligibility of those areas for listing in the Register as part of the Jardine district remains unresolved. I believe we can proceed to consider their values in state planning in a manageable way.

5. Although we do not know whether the information HRA used to assess impact and propose mitigation remains current or complete, our comments on impact derive from that material. You may need to bring us up to date if changes in project planning have occurred.

In general, we are concerned about the extent of loss of structures within the area of Jardine that retains the best historic, architectural, and engineering integrity. In essence, as HRA describes, the area that they recommend as a district encompasses a collection of resources that--while not complete--gives visitors a fairly sound understanding of milling and management activities. It contains roughly 36 buildings or features. Of those, Homestake's plan includes removal of 21, including the arsenic plant which by size is especially domineering in current views of the town. While the mitigation measures that HRA proposes are sound ones for design of new construction and recordation of buildings to be lost, we strongly recommend that you work with

LETTER 9

the company to identify alternatives to at least some of the loss of historic features. The resources of that area, we believe, warrant energetic attempts to see what alternatives to loss are possible. That work may have occurred. We recommend that your permitting process examine the possibilities. For instance, have alternative road locations into the community been considered (that would alleviate the demolition of 5 historic buildings)? Can the new mine portal be built in such a way as to work around at least some of the existing buildings? Could the frame and concrete powderhouse (039) be incorporated into the new warehouse rather than demolished? Can the lab and mill facilities be shifted enough to retain more of the remnants in that vicinity (numbers 51-54)? Can the parking lot be shifted to another location so that it's construction doesn't result in removal of two buildings? Could several smaller parking lots be put in throughout the areea? We haven't seen any of the documentation regarding the arsenic plants which required removal. Is that a case of groundwater pollution rather than material which could be fenced? Has EPA or the Department of Health been involved in analysis of actions?

6. We don't begin our list of questions with the presumption that all historic buildings in Jardine can be retained. We do, however, urge your most active negotiations with the company on whether a greater survival rate is possible. The historic resources of Jardine, especially in this area, have been considered very spectacular. The reality is, of course, that much of what was Jardine has already been lost. Hence, we think energy directed toward some preservation is very warranted before so much of Jardine which has educational and associates value is lost.

We leave the sequence of further consultation and discussion up to you. We do not know the speed with which you plan on approving a permit. We aren't sure where you are in EIS preparation and public review. We don't know where you are in consultation with the Forest Service. We may first need to talk with you about whether Homestake anticipates any impact in the areas of Jardine that we believe have potential district eligibility. If that is the case, we should then review that and provide you with comments on whether any mitigation or avoidance appears warranted. At some point, we should likely work with you on specific language for mitigation as conditions to your permit. We assume that that is quite a ways down the road.

Please call if you have questions.

Sincerely,

Marcella Sherfy,
State Historic Preservation Officer

cc: Alan Newell
Bill Olsen, EIS Team, DSL

LETTER 10

Clarence Johnson
Box 333
Gardiner , Montana
59030

12-10-85

Kit Walther , Chief
Environmental Analysis Bureau
Montana Department of State Lands
Capitol Station
Helena , Montana 59602

RECEIVED
DEC 13 1985
STATE LANDS

Kit Walther;

I am writing to voice my objection to approving a permit to opening the gold mine at Jardine , Montana by the Jardine Joint Venture.

I have lived and worked in the great outdoors around Jardine all of my life, (30years). My family has been involved in the outfitting business since the 1930,s in the Jardine area also.

I am opposing this mine onnumerous environmental and social issues. I will attempt to list these and expect definite positive answers before the permit is issued and if positive solutions cannot be made then I do not expect a permit to be issued, or approved.

A 1. Jardine is nestled between the Absaroka Wilderness and Yellowstone, which [illegible] two of the [illegible] eco_ systems in the world.

The soil erosion and possiable collapse of the tailings dump , which by the way is planned on an unstable bench, that is already washing away and could possibly collapse and clog or poison Bear Creek which flows into The Yellowstone River not two hundred yards from the north boundary of Yellowstone National Park. This is an unnecessary risk to be taking to such a great unpolluted river.

B 2. This area is critical Grizzly Bear habitat. This is documented by your own E.I.S. The Grizzly Bear is in danger of becoming extinct and we cannot afford to lose even a few acres of prime habitat. The noise, construction, increased population, day and night operations will cause the grizzly to move to other areas that are marginal habitats and will cause death for this great bear.

Any other (rancher_ sheepherder - outfitter ,) would not be allowed to move in and displace this bear , why should a giant corporation be allowed to do so ? This is reason in itself to deny any permits.

C 3. This area is famous for its elk migration and winter game range. We need every acre of range available. The tailings dump will wreck almost 200 hundred acres of prime winter range. This area supports a lot of deer and elk in the winter.

D 4.(A). POISON. The tailings dump will seep into small pot holes of water and will poison numerous big and small animals. This has already happened near Thompson Falls, Montana. This may only poison a few animals, but I sure wouldnot want to be the one who eats one of the"toxic few".

If the permit is granted, I feel the Jardine Joint Venture should be forced to erect a game proof fence around the entire tailings area.

E 5. There is an idea of creating a buffer zone around Yellowstone Park being talked about in congress. Any responsiable state agency should put any permit on hold until this matter is decided on.

F 6. Noise. Since about 1974 we have been plauged by noise from the exploration going on in Jardine. Lately it has gotten much worse , to the point of rattling windows and doors on our houses. Some nights it is impossiable to sleep or watch television.

A Soil erosion on the dump slopes would not jeopardize the stability of the dump. Although soil erosion would occur, the applicant's reclamation plan would prevent excessive soil losses (see Chapter III--Geology, Geomorphic Stability, and Soils, Tailings Dump). The method of tailings disposal and design of the tailings facility would produce a tailings dump that would be stable. Water would be removed from the tailings. Moisture in the unsaturated tailings would be controlled by an underdrain system. In an unsaturated state, the tailings would have low susceptibility to liquifaction under seismic-induced loading. In addition, the unsaturated tailings would be deposited behind a toe embankment, and all surfaces except for the working face would be sloped at a 3 (horizontal) to 1 (vertical) ratio. Stability analyses using the design concepts prepared by SRK show that the tailings dump would be stable under static and seismic conditions. Stability analyses also show that if no significant seepage is created by the proposed disposal facility, the stability of the Bear Creek terrace would not be adversely affected by the tailings dump. Significant seepage would be unlikely because the design incorporates a double liner, underdrain system, and monitoring systems. Without seepage from the dump, it is believed that a geologic time scale would be involved before sufficient failure of the terrace takes place to undercut the proposed tailings dump.

B The initial displacement of grizzly bears is discussed in the draft. Displaced grizzlies would not necessarily die. Suitable habitats surround the permit area (see figure II-19). Displaced individuals could encounter aggression or competition from grizzlies residing in surrounding habitats (see revised text). However, because this situation would be dependent on several unpredictable variables (that is, displacement distance, food availability, season, and age and sex of bears), projecting grizzly mortality is highly speculative. The habituation of grizzlies to mining activity would eventually reduce displacement.

State and federal laws allow for the Jardine Joint Venture to apply for a mining permit. If all laws and agency requirements are followed, mining would be permitted. Other uses of the area can occur providing appropriate laws and requirements are followed.

C The tailings facilities would remove 60 acres of elk winter range. The disturbed areas would be reclaimed. Chapter III of the draft discusses impacts on elk and mule deer (see Wildlife).

D Seepage water would drain to a small collection pond. The applicant would build a 7-foot-tall, woven-wire fence around the pond. A similar fence around the return water pond would be required. Although the tailings material is of concern, a potential for poisoning has not been clearly demonstrated. Therefore, the applicant's monitoring proposal and contingency plans are appropriate. Please see letter 20, response JJ, and the revised text.

E Provisions of the Metal Mine Reclamation Act require DSL to act on all operating permit applications within a legislated time period. DSL does not have the option of deferring its permitting responsibilities.

F Please see letter 32, response N.

LETTER 10

Page two ... Clarence Johnson vs. Kit Walther

6.(continued)

Working outside is almost unbearable most days. I see the noise getting much worse. This noise can be heard 5_10 miles into the Absaroka _Beartooth Wilderness Area and can even be heard the same distance into Yellowstone National Park when machinery is operating on the mountain tops such as bald Mountain or Crevasse Mountain.This is a shame as these two areas were set aside to prevent this kind of man made intrusion.

This is a concern voiced by every resident of Jardine and we think very strict noise controls should be implemented. I am talking about residents who are not working for the mine.

G 7. Water, The Joint Venture has applied for about 6000 times the amount of water that flows into or through Bear Creek. Where is this going to come from? A faithful employee from the mine has told me a dam on Bear Creek is planned. I am opposed to this also and will instigate a lawsuit on environmental grounds against it.

Why let a mining company wreck our fishing and recreation?

H 8. People, I hear so much about hiring 80 % of the work force locally. This is just not true. With Montana a union state and so many union miners out of work in Montana and surrounding states, do you really think unskilled, local miners will be hired?

I 8. With every "boom town" comes an undesirable element, Drugs, pushers, bums, drunks,thieves, murders,rapists etc. Why should we have to put up with this kind of "Riff_Raff", so some giant corporation can make a few million dollars?

J 9. This area is one of the greatest tourist attractions in the world. It also boasts some of the greatest hunting and fishing in the world. Why cannot we keep it this way for the millions who come to visit instead of the few who want to rape this country for a profit ?

Tourists do not want to come look at a bunch of machinery or a toxic tailings dump. They want to see and feel the wonders of God, The Absaroka Beartooth Wilderness Area and Yellowstone Park.

K 10. What is the air going to smell like around here , sulphur?

In summary, I feel that I have brought up a lot of valid points that would make one wonder if a permit should be issued for this project. It will harm and displace fish and wildlife including one endangered species, the grizzly bear, pollute our creeks, wilderness and Yellowstone Park, pollute our air, totally change our lifestyle we are accustomed to living and create traffic hazards on an already hazardous road and generally do more harm than good.

In closing I am going to ask you to take another hard look at this permit and see if it is really worth giving up all of what i have mentioned, just so an out of state and a foreign mining company can make millions.

God help us,

Clarence Johnson

G Page III-6 of the draft EIS states:

> Homestake Mining Company has submitted 25 water rights claims on Bear Creek totalling 201.6 cubic feet per second (Department of Natural Resources and Conservation, 1985), or about 6,000 times as much water as is needed to satisfy the requirements of the proposed project.

Construction of a dam on Bear Creek or any of its tributaries has not been proposed by the applicant.

The draft EIS does not predict that mining activities would destroy fishing and recreational opportunities in the Bear Creek basin.

H The JJV has committed to hire and train local workers, and company representatives have publicly stated the 80-percent goal many times. The number and skills of unemployed persons in Park County compares favorably with the number and skill level of workers needed by the JJV. If less than 80 percent of the work force is hired locally, and if such hiring produces an influx of newcomers, the JJV would be required to mitigate any impacts caused by such hiring procedures. The JJV and Park County agreed to monitor the hiring and location of project employees. If the assumptions used in the hard-rock mine impact mitigation plan (including 80 percent local hire) prove to be incorrect and unanticipated impacts occur to government services, then the county may petition the Hard-Rock Mine Impact Mitigation Board to amend the plan within two years of the start of commercial production. The JJV is responsible to pay all increased capital and net operating costs under the Hard-Rock Mine Impact Mitigation Act. The greater the number of locally hired workers, the smaller the impact and associated cost to the JJV, providing an incentive to achieve the 80-percent goal.

I Gardiner should not become a boom town due to the JJV project. Job seekers or newcomers would probably be very much like the current area residents. The project would bring fewer, less diverse people into the area than does Yellowstone Park and other local recreational attractions.

J The agencies recognize the environmental values of the Gardiner-Jardine area; however, the lands outside the park are open to mineral entry and development. The proposed project must meet all state and federal environmental laws and regulations, which have been developed to protect the existing values.

K The air would smell no different from today's air with the proposed mine.

LETTER 11

This letter is a typed reproduction of a handwritten,
signed letter that was received by the Department.
The letter was typed for ease of reading after publication.

December 11, 1985

State Dept. of Lands:

In comment to the Jardine Joint Venture's planned gold mine. I feel the advantages by a large margin. In a county where the unemployment rate is one of the highest in the state and new business is all but extinct, I feel Park County and Montana needs this mine.

I attended the public meeting December 3 and was a little amused by some of the public's responses.

One of the main concerns was the added traffic on the Jardine Road that the mine would bring. I didn't hear one comment about the traffic that logging causes and only little concern about hunters. The only group that offered support for renovation and maintenance was the Jardine Joint Venture.

Another concern was wildlife. Some people made it sound like the elk migrate right through Jardine and mine property, when in fact that mina migration is 1-2 miles downstream from Jardine. I feel that horn hunters disrupt the migration more than any other facotr.

As for the grizzly bears, it seems that whenever they do come into or around Jardine and Gardiner, the same people that are against the mine are the first to call the Fish and Wildlife to remove the bears.

There are some problems that do have to be worked out. I'm hopeful that the State and all concerned parties can solve them. I have lived in Gardiner for 22 years. I support the Jardine Joint Venture 100%. I am employed by the mine now and hope to be for the next 20 years.

Greg Vandersink
Box 236
Gardiner, MT 59030

Comment noted, thank you.

LETTER 12

DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION

TED SCHWINDEN, GOVERNOR
1520 EAST SIXTH AVENUE

STATE OF MONTANA

DIRECTOR'S OFFICE (406) 444-6699
HELENA, MONTANA 59620

STATE LANDS
DEC 16 1985
RECEIVED

MEMORANDUM

TO: Kit Walther, Environmental Analysis Bureau Chief
Department of State Lands

FROM: Carole I. Massman, Administrative Officer
Department of Natural Resources and Conservation

RE: Jardine Joint Venture Project

DATE: December 16, 1985

The Montana Department of Natural Resources and Conservation (DNRC) offers the following comments on the draft Environmental Impact Statement (DEIS) written on the referenced project.

A 1. DNRC's administration of the Montana Water Use Act should be included in the "Agency Responsibilities" section beginning on page IN-7.

B 2. Questions regarding the proposed 69-kV transmission line from the Gardiner substation to the mine site have been directed to DNRC. However, the Major Facility Siting Act covers only lines of more than 69-kV capacity. Therefore, DNRC has no review authority over this aspect of the project.

C 3. The DEIS sections reviewed, including those on the subjects of hydrology, water rights, soils, and reclamation, were thorough and accurate.

DNRC appreciates the opportunity to review this DEIS. Your bureau staff should be complimented for a job well done in its preparation.

cc: Rich Brasch
Wayne Wetzel
Pete Husby

CENTRALIZED SERVICES DIVISION (406) 444-6700
CONSERVATION DISTRICTS DIVISION (406) 444-6667
ENERGY DIVISION (406) 444-6697
OIL AND GAS DIVISION (406) 444-6675
WATER RESOURCES DIVISION (406) 444-6601

A Comment noted, thank you. Please note the text revision in the final EIS.

B Comment noted, thank you.

C Comment noted, thank you.

LETTER 13

AMERICAN COPPER & NICKEL COMPANY, INC.
USA Regional Headquarters
4860 Robb Street
Wheat Ridge, Colorado 80033
303 425 1230

December 13, 1985

Mr. Kit Walther
Chief
Environmental Analysis Bureau
Montana Department of State Lands
1625 11th Avenue
Helena, MT 59620

RECEIVED
DEC 16 1985
STATE LANDS

RE: Jardine Joint Venture Project -
Draft Environmental Impact Statement

Dear Mr. Walther:

The Jardine Joint Venture (JJV) appreciates this opportunity to comment on the JJV Project Draft Environmental Impact Statement (DEIS). These comments are being submitted on behalf of the JJV by American Copper and Nickel Company, as operator at the Project.

The comments are organized according to the DEIS format, and are offered as follows:

SUMMARY

A Figure S-1, Page ii

It would seem more appropriate to use Livingston (county seat), or Gardiner (nearest community) as the reference location for Jardine, rather than Yellowstone National Park.

B The Applicants Proposal, Page iii, Para. 1

The milling rate of 750 tons per day, operating seven days per week, should be included for further clarification of relative project size (see DEIS, page I-1, para. 2).

Preferred Alternatives, Page iv

Access road alternatives and employee busing will be discussed below.

SUMMARY OF IMPACTS BY DISCIPLINE

C Geology, Page iv

In reference to the tailings impoundment diversion ditch, all diversions will be designed by a qualified engineer using accepted methods to safely conduct the

INCO LIMITED, A CANADIAN COMPANY, IS THE SHAREHOLDER OF AMERICAN COPPER & NICKEL, INC.

A The proposed mine would be within 2 miles of Yellowstone National Park. This unique location justifies using the Park as a reference point. The towns of Livingston and Gardiner both appear as points of reference in Figure S-1 of the EIS.

B Please note that the milling information to which you refer is in that same paragraph (fifth sentence, 2nd paragraph, p. I-1, DEIS).

C The Jardine Joint Venture permit application specified the size of the riprap to be used and the slope gradient of the diversion channel. Based on this information, the diversion channel would experience erosional downcutting problems during flood events greater than 100-year event. Although we understand that some aspects of the applicant's plans would change as more detailed

LETTER 13

Mr. Kit Walther
December 13, 1985
Page 2

estimated peak flows. Until final design of the ditches is performed, exact slopes, channel size, and the size of riprap cannot be given.

D Wildlife, Page v

What basis is there for assuming an increase in poaching and antler collecting, as a result of the proposed JJV Project? An argument could be made that through company policies, and the increased attention drawn to the Jardine area by the proposed project, a decrease in these activities may result.

E Sociology - Social Life, Page vi

The statement is made that "Residents in the Gardiner area vary both in their perception of how the Project may affect the area...". However, only negative perceptions are discussed.

F Aesthetics, Page vii

Only topographic features of the Jardine general area are visible from the upper Mammoth terraces. The proposed operation will not be visible from the town of Mammoth, including the Yellowstone Lodge.

INTRODUCTION

Previous Research

G Sources of Information, Page IN-4, Para. 3

Although Western Technology and Engineering, Inc. (Westech) was hired by the JJV, the firm was accountable to an Interagency Task Force. By Memorandum of Understanding, all research study plans were reviewed and approved by the Task Force prior to implementation by Westech. Study development and subsequent reports generated were also closely monitored by the Task Force.

CHAPTER I: THE PROJECT, ALTERNATIVES, AND OTHER ACTIVITIES

Jardine Joint Venture's Proposal

H Tailings Disposal, Page I-6, Para. 1

In addition to depositing the dewatered tailings using a conveyor-stacker operation, other alternatives may include a loader, loader-truck, or, pneumatic conveyance.

engineering studies become available, we are legally required to assess the merits of the JJV's plans as presented in the permit application. If the necessary details are not present, then a worst-case assessment must be performed. Options for improving the design of the tailings waste dump runoff diversion system are presented in the EIS and are considered viable solutions.

D The Recreation and Poaching subsections (Chapter III--Indirect Impacts) of the EIS more completely discuss the increases. Company policies listed in volume IV-A of the permit application are non-specific and apply primarily to the permit area. They would be marginally effective in reducing poaching or antler collecting. Drawing attention to the Jardine area to reduce poaching is of questionable value.

E Comment noted. Please see revision.

F Portions of the project--in particular, the tailings dump--would be visible from the town of Mammoth, according to unofficial surveys by agency personnel

G Although research and study plans were reviewed and approved by the task force, Western Technology and Engineering, Inc. is responsible for the quality of the final reports submitted to DSL, as well as for the manner in which approved study plans are implemented.

H The other options mentioned for handling the dewatered tailings have been incorporated into the revised text.

LETTER 13

Mr. Kit Walther
December 13, 1985
Page 3

ALTERNATIVES

I Mine Access Road Alternatives, Page I-12

The location of the proposed mine access road could be shifted slightly to the southwest, and thereby avoid all historic structures in Jardine, while at the same time providing adequate access to the mine area.

Alternative 1, while avoiding historic structures in Jardine, would actually impact more active residences in the Jardine area than either the existing road or the proposed road. The town of Jardine would also be essentially "sandwiched" between the existing Bear Creek road (which would remain in use), and the road suggested as Alternative 1. This road would also be extremely difficult to construct across Bear Creek due to engineering considerations resulting from the existing topography.

The JJV concurs that Alternative 2 is not acceptable.

As an additional alternative, the present Jardine access road could be used, by widening the existing bridge over Bear Creek. This alternative would have the advantage of utilizing an established road, and would avoid impacting any historic structures in Jardine.

J County Road Alternatives, Page I-12

The existing Gardiner-Jardine road can be improved to adequately reduce hazard potential and inconvenience. Use of the existing road was approved by the Hard Rock Mining Impact Board, as part of the Hard Rock Mining Impact Mitigation Plan, and is preferred by the Park County Commissioners.

It is recommended that Alternative route A be rejected for the following reasons:

a. The Park County Commissioners have indicted that even if Alternative route A is constructed, the existing Gardiner-Jardine road will remain in use. The result will be two access roads parallel to each other, within a very close radius. This will result in essentially a doubling of the impact.

b. Traffic, including those driving to the proposed JJV Project, cannot be restricted to Alternative route A. It is probable that the existing road will remain the primary access to Jardine. Use of Alternative route A would therefore result in a relatively insignificant reduction in overall traffic volume on the existing Gardiner-Jardine road.

c. Alternative route A would be located in elk winter range, adjacent to winter range concentrations areas.

I Comment noted. Please see revised Chapters I and IV of the final EIS.

J Use of the Z-Hill Road is considered superior to alternatives due to the commitment by the JJV to reduce mine-related traffic and to improve the existing Z-Hill Road. DSL believes that construction of alternative routes is feasible since constructing an alternative mine access route was originally preferred by the JJV. However, due to the traffic mitigation plan proposed by the JJV and improvements to be made to the Z-Hill Road, other alternatives are inferior. A further benefit of the Z-Hill Road alternative is the reduction of public hazard along the road for all travelers.

LETTER 13

d. Alternative route A would be highly visible from Gardiner and Yellowstone National Park.

e. Geologic conditions exist through proposed Alternative route A (multiple shears, faults, and basalt flows), which would result in poor construction conditions and high maintenance costs for Park County. It is also questionable as to whether any benefits would result from changing the present one mile, 8% grade, to over 2.5 miles at 6% grade.

The JJV agrees that Alternative route B is not considered feasible.

A general understanding was reached at a meeting between the Park County Commissioners, Park County Planner, representatives of the State Highway Department, and representatives of the JJV, that upgrading the existing Gardiner-Jardine road was preferable to relocation of the road. A "Preliminary Jardine Road Evaluation" has been completed. As part of the approved Hard Rock Mining Impact Mitigation Plan, the JJV has committed up to $500,000 for work on the Gardiner-Jardine road, to include: detailed engineering; widening and "daylighting" of the road as necessary; reduction of the grade on Z hill; guardrails where needed; dust control in Gardiner and Jardine; and, implementation of speed reduction measures in Gardiner.

CHAPTER II: THE EXISTING ENVIRONMENT

K Figure II-6, Page II-19

The gravel pit and wash plant should be located to the north of the location indicated in Figure II-6, above the soil stockpile, and off of the alluvial terraces. Any introduction of water to the terraces could increase the potential for further slope failure along Bear Creek.

CHAPTER III: IMPACTS OF THE PROPOSED PROJECT

Geology

L Geomorphic Stability, Page III-1, Para. 2

As stated above, the statements on erosion potential do not seem appropriate, as the diversion ditches have yet to be designed.

M Earthquakes, Page III-4, Para. 2

The statement that rupture of the liner could take place during a major earthquake event needs expansion and clarification. The probability of the occurrence of the major earthquake event is considered very low during the operating life of the impoundment. The data presented in Appendix 5 of the DEIS indicates this low probability. Secondly, the likelihood that a rupture of the

K We agree that moving the gravel pit and wash plant to the north would be better than the original location.

Please refer to revised Figure I-2.

L Please see response to comment C.

M We agree that the liner system below the tailings dump would probably not rupture, especially considering the short (20-year) operating life of the mine. However, differential settlement of material within the terrace and below the tailings dump is still possible, especially over the long term, and such differential settlement could compromise the integrity of the liner. Adding millions of tons of tailings to the terrace could cause differential settlement especially if severe ground shaking were to occur at the site. In addition, there are saturated layers within the terrace that could deform during a strong earthquake.

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liner would occur is also considered to be minor, even in a major earthquake event. Ground rupture is generally localized in close proximity to the active fault involved in the earthquake. Ground displacement remote from the shear zone is primarily associated with mass instability or land slide movement. Limited potential of mass instability is considered to exist at the tailings disposal site. Liquifaction of subsurface material is not considered likely in the terrace materials due to their nature. Cracking and sloughing of the terrace face above Bear Creek is to be anticipated during a major earthquake. However, should sufficient sloughing take place to retreat cracking back to the tailings impoundment, it can also be anticipated that catastrophic failure would have occurred along the remainder of Bear Creek and the Yellowstone River. The relative impact of failure of the liner to such failure would be minor. Monitoring of the vadose zone following this event would be considered academic.

Finally, rupture of the liner would have minimal impact upon the groundwater regime. The available volume of residual solution in the dewatered tailings is small and its migration would be controlled by unsaturated flow conditions.

N Mitigating Measures, Page III-5, Para. 1 and 2

Again, design of the diversion has not been and will not be completed until final design of the facilities. Preliminary design indicates 18 to 20-inch riprap would be adequate. It is possible d_{50}, the median diameter, is being confused with the diameter of the stone.

The proposal of vadose zone monitoring is not considered valid for the following reasons. Initially, it should be considered that: the tailings themselves are unsaturated; the liner has a drainage system designed to reduce any driving head to seepage; and, that the volume of available solution that could seep in the unlikely event of a liner failure is small. Vadose zone monitoring can either involve remote sensing of changes in the moisture condition of the soils or direct sampling of soil moisture. Remote sensing methods are either geophysical and measure parameters such as resistivity or are single point devices measuring soil suction pressures. In order to evaluate these methods, a base case or steady state condition must exist in the material to which subsequent conditions are compared. Such monitoring systems are sometimes suitable for installation beneath facilities such as solution ponds if subsurface conditions are relatively homogeneous. The proposed tails disposal facility is likely to cause changes in the ground moisture regime simply by sealing the ground surface. These changes will be superimposed upon the natural seasonal changes in ground moisture. The bedded and variable nature of the subsoils is also far from homogeneous. It is therefore considered unlikely that remote sensing will allow definitive evaluation of changes in the vadose zone. Secondly, if a change is perceived, unless the nature of the moisture change can be determined, it would not be possible to differentiate between a leak in the liner and natural moisture changes.

However, we also agree with you that the amount of tailings water within the dump would decrease over time and probably be so small that even a severe rupture of the liner would not be significant. The wording of this section in the final EIS has been modified to more clearly stress these points.

DSL agrees that because JJV would essentially be depositing a "dry" tailings, rupture of the liner would minimize the impact on the ground water regime. However, DSL also agrees with ACNC's own analysis in comment K, which states: "Any introduction of water to the terraces could increase the potential for further slope failure along Bear Creek." Slope failure is considered to be a serious environmental concern.

The updated hydrologic monitoring plan is presented in Appendix 15.

N See response to comment C for a discussion of the diversion channel.

Monitoring would be required to assure that the tailings dump facility is working as designed and therefore is not degrading surface or ground water quality (see Chapter III--Hydrology, Mitigating Measures).

DSL is committed to implementing a comprehensive monitoring program that provides meaningful data. DSL's primary concern is protecting the quality of the existing environment and safeguarding the public's health, safety, and general welfare. The updated hydrologic monitoring plan is presented in Appendix 15.

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Any monitoring system should therefore sample soil moisture. Monitoring of unsaturated flow is limited to the sphere of influence of the monitoring equipment. The disposal facility has a total foundation area of approximately 1.5 x 10^6 ft.^{2}. If lysimeters are used, it can be conservatively assumed that a single instrument might monitor 2 ft.^{2} of soil area. Even if 1,000 instruments were installed, only 0.13 percent of the foundation area would be monitored. Puncture of the synthetic liner system, if this were to occur, is likely to consist of small pinhole failures. The probability of detecting seepage from such a failure is small. Maintenance and sampling of this number of instruments is also not considered practical. Estimating each installation (lysimeter, tubing, accessories, and labor) at $250, the economics of a large number of devices is questionable in comparison to their possible effectiveness.

In a situation where leakage through a liner is occurring, the permeability of the subsoils will be dictated by the permeability of the tailings to maintain a flow balance across the interface of the two materials. Assuming the unsaturated permeability of the tailings to be 10^{-7} cm/sec, a lysimeter located 2 ft. below the interface would take several years to detect contaminant after the leak occurred. Depending upon the assumptions made, detection of the seepage could take longer than the operating life of the facility.

In considering the above, vadose zone monitoring is simply an academic and expensive exercise.

HYDROLOGY

O Water Availability, Page III-6, Para. 3

What is being implied by the statement, "Homestake Mining Company has submitted 25 water rights totaling 201.6 cubic feet...or about 6,000 times as much water...? In most cases, the water rights were obtained with the property purchase. The minimal withdrawal required by the proposed JJV Project will not be generally detectable at the flow rates found in Bear Creek.

P Ore Processing Reagents, Page III-8, Para. 1

The use of values of 1.31 mg/l total filterable cyanide and 3.7 mg/l arsenic are not applicable in the context of the text. These values are extremes and require specific conditions to be achieved. Significantly lower values are to be anticipated under operating conditions at the tailings impoundment.

Q Water Quality Monitoring, Page III-9

It is recommended that monitoring be done at Station 001A, unless activities extend north of Pine Creek. Station 001 is inaccessible during the winter, and occasionally during high flow.

O This statement implies that JJV could be speculating in water rights. If water rights claims for 201.6 cubic feet per second are actually adjudicated by the Montana Water Court, these rights (which have an early priority date) could be transferred or sold. The question would then be, to whom and for what purpose?

In December 1984, Enco Development Corporation, P.O. Box 5663, Bellingham, Washington 48227, filed a preliminary permit application with the Federal Energy Regulatory Commissioner (FERC) to develop a 400-kilowatt hydroelectric facility in the Bear Creek basin.

In order to maximize electrical production, Enco would want to maximize its use of the water from Bear Creek. Therefore, if JJV water rights were adjudicated, a transfer of these water rights to Enco, or another industrial or agricultural water user, would be possible.

P Data contained in Table III-4 were provided to DSL by JJV.

Q Comment noted. Appendix 15 presents the updated hydrologic monitoring plan.

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Daily sampling of cyanide is extremely excessive and expensive. It is difficult to understand the value of such monitoring. Cyanide amenable to chlorination could be added to the seasonal monitoring program at Stations 001A and 010. Additional sampling of Bear Creek for cyanide (quarterly) was performed during 1985. All samples indicated no detectable cyanide.

Monitoring arsenic, iron, manganese, and sulfate on a monthly frequency would be excessive.

Nitrogen and fecal coliform can be good indicators of contamination by sewage. However, it should be noted that there is a considerable amount of other human and livestock activity in the area that can affect these values. Also, the allowable holding time for fecal coliform is six hours. The closest lab is in Helena or Billings. Getting a sample to these places on time, by conventional transporation, may not always be possible. It may be just as useful to analyze for nitrogen, and if an increase in concentration occurs, sample for fecal coliform to help identify the source.

R Potential Sources for Ground Water Contamination, Page III-10

As discussed above, the test referenced is an extreme case and does not reflect anticipated concentrations of potential contaminants. The values given in Table III-4 of the DEIS are high. If these figures are the basis for the calculation on page III-11 of arsenic values, the result of 22 gpm would be low.

S Mitigating Measures, Page III-12

While it may prove possible to use some of the sediment pond water for irrigation in reclamation, it may not be practical to plan on it with certainty. The ponds will only have water in them for a short time after a precipitation event. The water will probably seep away from the sediment pond by the time the area dries out enough to utilize additional water for irrigation.

The JJV has already substantially committed to revegetating road cut and fill slopes.

It is not practical to limit an already short construction season further. The DEIS does not demonstrate that probable maximum precipitation events occur prior to the month of July. Designing the operation to minimize the area disturbed at any one time in conjunction with interim vegetation of disturbed areas and phase revegetation of the tailings disposal area, is viewed as more important in reducing soil erosion than restrictions on timing of disturbances.

The reference to sulfide flotation on page III-14, paragraph 1, appears incorrect. It is assumed reference is made to the cyanide process.

The comparison to EPA guidelines is questionable. The mine waste is neither defined as hazardous or covered by RCRA guidelines. The suggestion of monitoring the vadose zone has been discussed above.

R Please refer to response P.

S 1. Through time, "fines" would seal the bottom of the pond and thereby drastically reduce the overall permeability of the pond. Furthermore, water could be pumped into tanker trucks to control dust at a later date.

Because the ponds are designed to handle a 10-year, 24-hour storm event, and there is always the chance any number of these events could take place in a short period of time, draining the ponds as soon as possible seems prudent for two reasons:

a) it decreases the sediment loading to Bear Creek,
b) it decreases the overall project water requirement.

2. Please see letter 6, response A.

3. The DEIS does not attempt to demonstrate that probable maximum precipitation events occur before the month of July. Figure II-23 of the draft EIS presents a graph which portrays dramatically the fact that, on the average, May and June receive the largest amounts of precipitation. Large amounts of precipitation affect soil tilth, a factor that must be considered when discussing the potential for soil erosion and sediment loading.

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DSL reminds JJV that Volume III, part D, page 11 of the JJV permit application states:

"Every effort will be made to minimize compaction of soil material and to avoid excessive disruption of soil structure during soil handling operations. Soil will be handled only when it exhibits good tilth and is moderately dry (emphasis added)."

Common sense dictates that soils in the JJV project area would exhibit good tilth and be moderately dry sometime after May and June.

4. This assumption is correct, and the text has been reworded.

5. The EPA reference (Procedure Manual for Ground Water Monitoring of Solid Waste Disposal Facilities, 1980) presents a well-thought-out system for monitoring solid waste disposal facilities. The draft EIS does not suggest that wastes associated with the JJV project would be legally classified as "hazardous." The Resource Conservation and Recovery Act (RCRA) specifically excludes mine wastes from being classified as "hazardous" even though these wastes may contain high levels of cyanide, which by itself is considered a hazardous material.

   The agencies feel that a comprehensive monitoring program must be implemented that provides meaningful data, protects the quality of the existing environment, and safeguards the public's health, safety, and welfare.

6. In August, 1984, as an addendum to the JJV permit application, DSL received a copy of a report prepared by JJV's consultants Steffen Robertson and Kirsten (SRK) titled Preliminary Design Report Jardine Tailings Disposal Facility, Jardine, Montana. This report presents the results of a sophisticated water balance analysis. Specifically, page 38 of the SRK report states:

> The conclusion of the water balance analysis is, therefore, to maintain the active operating area as small as possible. The proposed reclamation plan discussed in the following section describes how the active area may be maintained between 200,000 and 300,000ft^2 (4.59 acres and 6.89 acres).
>
> Deposition of tailings will initially take approximately 1.5 years to cover an area of 200,000 ft^2. Thereafter, an average of 100,000 ft^2 of area will be covered per year throughout the life of the project. The reclamation should therefore reclaim 100,000 ft^2 or 2.3 acres, per year to maintain the active unreclaimed area between 200,000 and 300,000 ft^2.

Based on the information presented by JJV's own consultant (SRK), it would appear that the six-acre criteria is certainly neither arbitrary nor unsubstantiated.

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It is not clear why six acres are recommended as the maximum active area. The design is capable of meeting the design criteria of zero discharge under conditions of a 100 year wet year plus 100 year flood volume, and still provide additional storage capacity of 300,000 ft.^{2} (7 acres). The six acre criteria appears arbitrary and without substantiation.

SOILS

T Tailings Dump, Page III-21, Para. 1

The assumption that the tailings will have similar properties to the historic tailings is not true in all cases. The oxidation of the historic tailings and acid generation is not anticipated in the proposed tailings disposal. Based on JJV data and SRK testing, the pH of the tails would be neutral to alkaline in the 7 to 9 range. With the sealing of the facility, potential for acid generation is alleviated.

VEGETATION

U Mitigating Measures, Page III-29

The JJV has proposed spring or fall seeding. The literature cited in the DEIS listing the benefits of fall seeding is based on research conducted at high-elevation or alpine sites. It is apparent that fall seeding may be desirable for alpine sites, however, Jardine is not an alpine site. A vast amount of literature is available showing that both spring and fall seedings have been successful on non-alpine sites. The flexibility of spring or fall seeding will allow for more timely revegetation of disturbed areas.

WILDLIFE

V Indirect Impacts, Pages 34 and 35, Para. 1

There is no evidence that road kills are currently a problem on the Jardine Road. It is not accurate to assume road kills will increase proportionally to traffic increases. Fencing in problem areas is suggested as a mitigating measure (DEIS, page III-38). If it is assumed that problem areas are also elk/deer migration paths, will fencing disrupt migration? Several of the project alternatives were rejected, partly because of their potential impacts to wildlife, particularly elk winter range and migration (DEIS, pages I-11 through I-15). Caution should therefore be exercised in recommending mitigations that may only replace one problem with another (perhaps more severe) problem.

T This assumption was made because limited information was provided in the application regarding the chemical nature of the tailings that would be produced by the operation. DSL felt that the analysis of the historic tailings presents a worst-case condition; therefore, because limited chemical information was available, this information was used in the analysis.

We do not fully agree with the last sentence of your comment. Because of such things as settlement, frost action, minor seismic events, and the action of plant roots, the bentonite seal at the surface is expected to crack in places over time, exposing some of the tailings at the surface (beneath the soil cover) to oxidation and other weathering processes. In other words, the impoundment would not be air-tight, as your comment suggests. However, even with some cracking, no plant toxicity problems are expected for reasons discussed in the EIS (see Chapter III--Soils, Tailings Dump).

U The applicant would retain the option of spring or fall seeding. We recommend fall seeding if possible. Regardless of Jardine's elevation, the listed advantages of fall seeding remain. Research at Colstrip, Montana (3,200 feet in elevation), indicates that fall seeding improves native species establishment and stand diversity (DePuit et al., 1978; DePuit and Coenenberg, 1979).

V Regardless of the current level of road kills, the assumption that increased traffic would lead to increased road kills is reasonable. The final EIS recognizes that the proposed traffic reduction would limit the kills. Fencing is one option available to reduce road kills. This option would be more suited to U.S. 89 than the county road. It must be assumed that migrations would be considered when designing and locating fences. Please see the revised mitigation. We agree with your other comments.

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W Mitigating Measures, Pages 37 through 38

The proposed four-strand, barbed-wire fence was intended for domestic livestock only, and was never intended for wildlife. The presence of the existing tailings has had no apparent adverse affect on wildlife in the area. Activity associated with operation of the proposed tailings, and the limited surface exposed at any one time, will further reduce the potential for impact to wildlife. Fencing the tailings area could also affect elk movements.

X The JJV has already committed to carpooling and providing bus transporation. However, employees cannot be required (i.e. "mandatory") to ride buses.

Y As stated on page III-36 of the DEIS, the JJV has proposed several measures to discourage poaching or wildlife harassment by mine employees. The JJV supports increased law enforcement activity by the Department of Fish, Wildlife and Parks, or other legal entities.

Z Is there any evidence that limiting major construction from December 15 - May 5 would significantly increase elk use of habitat close to the permit area? Would the habituation process referred to in para. 2, page III-33 of the DEIS, offset this mitigation measure? What comprises "major" construction?

AA Prohibiting people from entering big game ranges during winter, and modifications to timber sales is the responsibility of the U.S. Forest Service, rather than the JJV. While the JJV supports these measures, it has no control over their implementation.

THREATENED AND ENDANGERED SPECIES

BB Direct Impacts, Page III-39, Para. 2

There is no evidence that grizzly bears have been poisoned by consuming the existing tailings, which have been in place for nearly 50 years. It is therefore not anticipated that bears will be attracted to, and consume tailings generated with the proposed JJV Project.

CC Indirect Impacts, Page III-41, Para. 5

The conclusion that poaching will increase simply because more people will use the area, by referencing construction of the Alaska pipeline, is not valid. Cosntruction of the pipeline in Alaska, and development of the proposed JJV Project in Montana, are extremely dissimilar.

DD Mitigating Measures, Page III-42

The JJV agrees that, as with elk fencing, bear-proof fencing should not be installed unless a problem develops.

W We agree with your comments. However, the presence of the tailings in high-density mule deer and elk ranges is of concern (see Chapter III--Direct Impacts). A fence would be required only if monitoring demonstrates its necessity. Please see the revised text.

X Bus ridership does not have to be mandatory to be effective. The JJV can design measures to make bus transportation attractive to employees in order to make bussing effective. For example, parking at the project site could be limited. DSL has encouraged the JJV to design a plan in order to give the JJV flexibility.

Y Comment noted, thank you.

Z The assumption that limiting construction would decrease displacement of elk is reasonable. The significance of this decrease cannot be predicted. Although habituation would eventually reduce displacement, limiting construction would still be beneficial. The final EIS recognizes that the applicant's commitment to salvage soil only during periods of good tilth satisfies the intent of the mitigation.

AA Comment noted, thank you.

BB Comment noted, thank you. However, the presence of tailings in the range of a threatened species and its prey is of concern.

CC We feel the paragraph presents a fair assessment of the potential problem. Klein (1979) was used as an example of the relationship between population increase and poaching. Despite the dissimilarity of the Alaska pipeline and JJV's proposal, this example is used appropriately.

DD Comment noted, thank you.

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EE It is agreed that removing carrion from the roadside could reduce grizzly or eagle activities near roads. The JJV questions whose responsibility it is to remove carrion, and further, who can legally do it. Where would the carrion be disposed? Could such disposal attract bears, eagles, or other carnivores to another site?

FF It should be noted that while the JJV could advise Jardine residents about proper garbage disposal, it cannot enforce such disposal. As described in the Operating Permit Application, the JJV intends to follow proper garbage disposal/storage practices within its permit area, but cannot require other Jardine residents to do the same.

AIR QUALITY

Tailings Dump, Page III-45, Para. 1 and 2

GG The emission factors referenced from Woodruff and Siddoway (1965), and from the U.S. Environmental Protection Agency (1976), are not related to dust emissions from hard rock tailings. The Woodruff emissions are based on soil erosion and the EPA factor is from eastern U.S. erosion and sediment control of surface mining. A more appropriate emission factor to use is the Air Quality Bureau emission factor of 0.6 tons per year, which was derived from research by the EPA.

HH The comment is made that "the estimated amount of emissions from the proposed tailings would be similar to the dust blowing from the 6.2 acres of existing tailings." For several reasons, the potential dust blowing from the proposed tailings would be significantly less than the dust blowing from the existing tailings. The existing tailings cover is approximately 20 acres, and in the past has been essentially uncontrolled for dust emissions. The proposed tailings would have a maximum of approximately 5 acres of tailings exposed at any one time. Dust emissions would be controlled through phased reclamation and a chemical binder, as necessary. The existing tailings have been recently treated with a chemical binder to control the dust emissions. Ultimately, the existing tailings will be contained in the proposed tailings impoundment.

Mitigating Measures, Page III-46

II As discussed above, emissions from the tailings is not anticipated to be a major source of dust. The use of water sprinkling is not a viable control measure with the tailings dam design proposed. However, the use of chemical binders on an as needed basis is possible.

JJ The JJV has committed to controlling dust on those portions of the road in Gardiner and Jardine.

EE Carrion removal is currently the responsibility of the Forest Service, the Montana Department of Highways, and the Montana Department of Fish, Wildlife and Parks. Their continuing efforts would keep most carrion off the road. The carrion would be either dragged from within sight of the road or deposited in a location agreed upon by the agencies. Carnivores could be attracted to the disposal site. Please see the revised text and mitigating measures.

FF We realize that JJV cannot enforce disposal policies. We do, however, recommend that JJV encourage proper disposal by providing containers and advice. This effort would reduce the potential for human/grizzly confrontations. Please see the revised mitigating measure.

GG There are numerous methods for estimating emissions from blowing tailings. The various methods would arrive at a wide range of values as noted. The lower emission factor used by the Air Quality Bureau is an attempt to estimate the expected actual emissions, taking into account the required as-necessary controls and proper diligence by the company, while the higher emission factors are more representative of uncontrolled or worst-case conditions. Additional discussion has been added to Chapter III.

HH The comment in the draft EIS refers to the worst-case situation with respect to the proposed tailings and was intended to relate this to the existing tailings at the time the baseline monitoring was done. The potential of possible emissions from the new tailings would be similar to that for the old tailings; however, the actual emissions would be significantly less for the reasons stated.

II Comment noted. The use of chemical stabilization is acceptable and consistent with the air quality permit requirements.

JJ Comment noted. This is a requirement of the air quality permit and has been included in Chapter III.

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Mr. Kit Walther
December 13, 1985
Page 11

SOCIOLOGY

KK Community Services, Page III-57, Para. 5

Reference is made as to the need for additional law enforcement personnel in Park County; however, page II-77 of the DEIS states that, "Statistics show that the current Park County Sheriff's Department has a higher number of officers than selected counties with comparable populations...".

TRANSPORTATION

LL Project Traffic, Page III-68, Para. 3

Ore trucks are listed as a source of traffic traveling to and from the proposed JJV Project. There will be no ore trucks traveling on the Jardine road. The estimate of 5 to 10 supply trucks per day is extremely high. The actual number would be substantially less.

Mitigating Measures, Page III-70

See discussions on employee busing above.

CHAPTER V: ACCESS ROAD ALTERNATIVES

See discussion on access road alternatives above.

The above Jardine Joint Venture comments on the Draft Environmental Impact Statement are offered to assist the Montana Department of State Lands in producing a final document that thoroughly addresses the environmental issues associated with the proposed project. Considerable environmental research and analysis has been performed on the Jardine Joint Venture Project by the applicant and the Department of State Lands. This will result in a final Environmental Impact Statement that will safeguard the environment in the Project area.

Sincerely,

R. T. Agar
Vice President
Manager

cc: Jerry Danni, HMC

KK Please note that the sentence to which you refer is stricken from the text. Since the draft EIS was published, the number of FTE officers in Park County has decreased from 9.5 to 8.0. The adequacy of government service levels is judged by citizens without reference to such statistics. Public survey and key informant interview responses indicated that taxpayers believe an additional deputy is needed.

LL Thank you for your comment. The reference was taken from the hard-rock mine impact mitigation plan written by the JJV's consultant, and reviewed and approved by JJV representatives prior to the publication of the draft EIS. The reference has been changed to reflect new estimates made by the JJV.

LETTER 14

P.O. Box 207
Gardiner, MT 59030
12/13/85

Kit Walther, Chief
Environmental Analysis Bureau
Reclamation Division
Montana Department of State Lands
1625 11th Avenue
Helena, MT 59620

RECEIVED
DEC 16 1985
STATE LANDS

Dear Mr. Walther,

I am writing to you with my concerns of the Jardine Joint Venture mining project. First let me thank you for having the public meeting on the draft EIS in Gardiner. I attended and believe alot was accomplished. I also urge you and your department to complete a final EIS.

A I believe it needs to be finalized on what will go into the septic system and what will go into the waste water (tailings) system. Where do they plan on having the laboratory sinks drain, the wash/change room?

B Concerning the road...First I object to having the new bridge constructed across Bear Creek on the George Athas property. I believe they can establish grades and turns by having the bridge constructed between Roller's house (their land) and Martin Ostrenga's house. Much of the Jardine "historic" district has already been torn down and/or burned since the 1950's so I see no reason why they can't build their bridge on their land. I do not know if the JJV has discussed the bridge project with George Athas or not. But as his step-daughter and a user of his property, I do not want to step out of the barn and have to be careful not to fall off the road cut into the turn for the bridge. I am not a surveyor and don't know if I "read" the map correctly but I do not want the bridge across George's land as I interpret the draft EIS.

C Secondly, as a resident of Gardiner and a frequent Jardine Road user, I believe any increase in traffic will have an impact. I would like a complete engineering study done on alternatives to coming down Z-Hill and past the Rocky Mountain Campground on the present road. I think that with modern construction techniques and dynamite that an alternative road could leave Z-Hill, go across the Travertine, and come out to US 89 somewhere around the Montana Power substation. This alternative road could also give MPC a cleared right-of-way and easier construction and maintenance for the new power line to Jardine. The rerouted road would eliminate traffic and a high line through a residential area. If the engineering study finds the alternative road impossible, I would like to see guard rails on Z-Hill. I would also want the Dept of State Lands to attend the Park County Commissioners meetings along with the residents and JJV to discuss road widening, safety features, etc.

D My other concern is the tailings pond; location, height of the piles, their impact on the elk migration, dust control, and the lining of all pipes to and from the ponds as well as the ponds themselves being leak proof.

A All wastes from the laboratory, the change rooms, and the mill would be routed to the mill system, which is separated from the septic tank-drainfield system. Only sanitary wastes would be routed to the drainfield for disposal.

B See response to letter #3, comment A, for a discussion of the merits of the various alternatives of accessing the mine area at Jardine. Please also see letter #13, comment I, from the American Copper and Nickel Company. This letter presents another option whereby the access road would be built on JJV property and yet avoid the historical structures of Jardine. Further analysis of mine access road alternatives has been discontinued in light of the applicant's revised plan to use the existing road and bridge. Please see Chapter I for a discussion of this road.

C Additional engineering studies are not necessary to compare the benefits of using the Z-Hill Road versus constructing a new mine access route. The JJV has committed to a traffic-reduction plan and to funding improvements to the Z-Hill Road which would significantly reduce the impact of mine-related traffic and would provide a safer road for all motorists. Constructing an alternative route would not reduce the potential safety problems on Z-Hill Road because the JJV cannot prohibit mine traffic from using the road. Furthermore, improvements would not be made to Z-Hill if an alternative road were constructed, potentially compounding increased safety risks. Electrical power line alternatives are discussed in Chapters I and IV.

D Please letter 10, response A.

The 33-percent slopes and 125-foot height of the proposed tailings dump would not adversely affect reclamation efforts (see Chapter III--Soils and Vegetation). Lowering the height of the tailings dump would increase the acreage disturbed and move the tailings closer to Bear Creek. The tailings dump would

LETTER 14

The tailings ponds are going to be placed above Bear Creek where the existing steep bank shows past and current seeping and slipage. I also think piles of height to 150 feet will be impossible to control and reclaim. Besides having such a large pond and piles of tailings will adversely affect the elk migration through this area. As a sportsman, hunter, and possible future land owner in Jardine (Pole Creek), I do not want to see the elk change their migration patterns to lower elevations (Eagle Creek, Travertine/Trail Creek, or the west side of the Yellowstone) and eliminate their migration from Baldy and Palmer Creek through Rex Coulee and Pole Creek. This change in migration would also eliminate, for all practical purposes, our family outfitting business for bull elk and for cow elk in the Late Season. I hope to build a house on George Athas' property in the future, but I do not want my view of Bear Gulch and Yellowstone blocked by tailings piles (raw or reclaimed). I would think that they could flatten out the tailings to a much lesser height.

Thank you.

Montana L. Lindstrom

Montana L. Lindstrom

not significantly affect elk migrations. Elk would move around the 5- to 9-acre areas of exposed tailings. They could also travel over the dump's slopes.

Chapter I discusses design considerations the JJV proposes to incorporate into the tailings slurry and return water pipelines. Chapter III--Geology discusses the implications of pipeline failures.

LETTER 15

DEPARTMENT OF THE ARMY
OMAHA DISTRICT CORPS OF ENGINEERS
6014 U.S. POST OFFICE AND COURTHOUSE
OMAHA, NEBRASKA 68102

REPLY TO
ATTENTION OF

December 5, 1985

Planning Division

RECEIVED
DEC 16 1985
STATE LANDS

Mr. Kit Walther, Chief
Environmental Analysis Branch
Montana Department of State Lands
Capitol Station
Helena, Montana 59620

Dear Mr. Walther:

We have reviewed the draft EIS for the Jardine Joint Venture Project. Our comments regarding Corps permit requirements, flood plain management, cultural resources and water quality are provided on the enclosed page. We have identified some concerns we have regarding designs provided to protect water quality.

Thank you for this review opportunity.

Sincerely,

Richard D. Gorton
Chief, Environmental Analysis Branch
Planning Division

Enclosure

LETTER 15

CORPS OF ENGINEERS COMMENTS
JARDIN JOINT VENTURE
DRAFT EIS
NOVEMBER 1985

A Permits.

As stated in the DEIS, any fill in any river required to replace or strengthen any bridge, (including construction of a new bridge if alternative route number one is selected), would require Department of the Army authorization pursuant to Section 404 of the Clean Water Act.

The method of obtaining the water required for the operation of the mine is not addressed. Here again, any filling activity in either Bear Creek or Pine Creek will require authorization from the Corps of Engineers pursuant to Section 404.

B FLoodplains.

The design of the proposed project including location of tailing piles should insure that the project is in compliance with flood plain management criterion of Park County and the State of Montana. As a minimum, the design should insure that the 100-year flood water surface elevation of any stream affected is not increased more than one foot relative to pre-project conditions.

C Cultural Resources.

The Montana Department of State Lands and the U.S. Forest Service appear to be doing an excellent job in the Section 106 compliance process (of the National Historic Preservation Act of 1966, as amended). They are at the appropriate stage of compliance for the draft EIS. We would recommend the mitigation plans which would avoid, protect, or reuse the historic properties.

A Please refer to Appendix 23 for a description of the water diversion system.

B The only construction the Jardine Joint Venture proposes in the 100-year flood plain of Bear Creek is widening and improving the existing bridge across the creek. The JJV would obtain the necessary permits to do so.

C Comment noted. The JJV has proposed a cultural resources mitigation plan as was suggested in the draft EIS.

LETTER 15

D Water Quality.

Alternatives should be considered to the septic system for handling sewage. The proximity of the system to Bear Creek may result in inadequate filtration before this water enters the creek. Total retention lagoons or a package treatment plant would provide greater design flexibility.

Design of the settling ponds for the 25 year flood event may be inadequate. Due to the phased land reclaimation schedule, a 50 year design would provide greater assurance that the tailings could be stabilized by vegetation.

Waters associated with the cyanidation process and arsenopyrite concentrations should be treated to remove arsenic, manganese, cyanide, and aluminum. Using other tailings, to dilute these pollutants should not be permitted when these pollutants are already in a concentrated form. Leaching from these wastes could cause problems for many years after the project has closed.

Sludge pond placement and design should be fully discussed. It is important that these ponds are protected from inundation or flushing during storm events.

What contingencies are proposed should leaks be detected in the synthetic membrane liner?

An evaluation of aluminum toxicity should include projected acid rain potential over the next 25 years. While acid rain has not been a major problem in Wyoming or Montana, it has occurred in these areas and is an increasing threat over time. Higher than expected acid mine drainage should also be discussed in respect to aluminum toxicity.

D

1. Please refer to the response to letter 6 comment D for a discussion regarding the location of the alternative septic tank/drainfield system.

2. Comment noted, thank you.

3. Mill effluent associated with the cyanide agitation circuit would be slurried to the tailings disposal area where a belt filter or cyclone separator would reduce the water content to about 15 percent. The water would be collected in a double-lined, return water pond and pumped back to the mill for reuse. There would be no discharges. Because mill effluent would be recycled, the total water make-up requirements and reagent application rates would be lower.

   The draft EIS does not predict that leaching from the tailings disposal area of arsenic, manganese, and aluminum would be a problem. In fact, the hydrology summary in Chapter III states that:

   > Two historic tailings impoundments would be removed and placed within the proposed tailings dump. This action would result in a decrease in the loading of cyanide, arsenic, and other heavy metals to the ground water system and Bear Creek.

4. Please refer to Appendix 16 for details regarding sludge pond placement and design. Note that a diversion ditch would protect the ponds from overtopping during storm events.

5. Contingencies for tailings dump seepage would be handled on a case-by-case basis. However, the tailings design, consisting of unsaturated tailings, an underdrain system, synthetic liner, and a clay liner under the synthetic liner, would drastically decrease the potential for any seepage from occurring.

6. According to Richard D. Gorton, Chief, Environmental Analysis Branch, Omaha District Corps of Engineers, no accepted methodology exists for projecting acid rain potential over the next 25 years (pers. comm., January 20, 1986). Furthermore, there are no federal or state water quality criteria or standards for aluminum. Acid mine drainage was not an impact predicted in the draft EIS.

LETTER 15

E General.

Page I-1. of the 1050 tons of ore mined per day, 750 tons would be milled daily. What would be the processing procedure for the remaining 300 tons/day?

E The mine would operate 5 days a week producing 1,050 tons of ore per day. The mill would operate 7 days a week milling 750 tons per day. On a weekly basis, the same amount of ore would be mined (5 x 1,050 tons = 5,250 tons) and milled (7 x 750 tons = 5,250).

LETTER 16

December 13, 1985

RECEIVED
DEC 16 1985
STATE LANDS

Mr. Kit Walter
Chief, Environmental Analysis Bureau
Montana Department of State Lands
Capitol Station
Helena, Montana 59620

Dear Kit,

I have enclosed a copy of my testimony from the public meeting in Gardiner on December 3. I would like to reiterate my concerns on three basic problems: the proposed access road to the Joint Venture project from U.S. 89, the location of the new 69-kilovolt transmission line, and the apparent discrepancy with water rights claims. I will concede that the problems concerning water rights are best handled through the adjudication process; however, I feel that the operating permit approval should include stipulations on the road and power line issues.

A Since the public meeting, I have obtained additional information concerning the access route. In the copy of the operating permit application which I received, the Jardine Joint Venture proposed an alternative route for mine access (Volume IV-C, p.14-15). The EIS, however, states that the Joint Venture has proposed to up-grade the existing road. Why this discrepancy? Isn't the EIS supposed to address the mine application? Was the proposed action changed?

B Carlo Cieri, a Park County Commissioner, gave me a copy of the Preliminary Jardine Road Evaluation, December, 1984. This was written by Mike McLean from the Joint Venture. This report states that members of the Park County Commission, representatives of the State Highway Department, the Park County Planner, and representatives of the Jardine Joint Venture reached a general understanding "that up-grading of the existing Jardine Road is preferable to relocation as suggested in the Jardine Joint Venture application for an operating permit." The report continues by dismissing the road relocation for the following three reasons: 1) negative environmental impact on animal travel routes, and high visibility from Gardiner/Yellowstone Park area; 2) geologic conditions through the proposed route (multiple shears, faults, and basalt flows) which would result in poor construction conditions and high maintenance costs for Park County; and 3) questionable grade modification benefits resulting from changing the present one mile at 8% to +2-1/2 miles at +/- 6%.

It appears that this decision was made without any input from the affected residents. They speak of negative environmental impacts, but there is no biological data to support that contention. Strange that the entire mining operation would not have a negative impact, but the road alternative alone would. High visibility hasn't discouraged the numerous roads which already cover the area. Also not mentioned are the two existing travertine quarries; I guess they are invisible. I appreciate the geologic problem, but again,

A The discrepancy between the EIS and the mine permit application is due to the differences between the draft and final hard-rock mine impact mitigation plan negotiated by the county and the JJV. The draft plan was included in the mine application permit and it stated that the applicant planned to construct a new mine-access road. The EIS quotes the final impact plan, which states that the Jardine Road would be upgraded and used by the JJV as the access road. The JJV will submit an amendment to the mine permit application stating that the Jardine Road would be upgraded and used as the access road.

The copy of the socioeconomic mitigation plan contained in the Jardine Joint Venture permit application titled "Synopsis of the Jardine Area Project Hard Rock Impact Mitigation Plan for Gardiner and Park County, Montana" was a preliminary version. The mitigation plan was changed after discussions with the Park County Commissioners. As you state later in your comment letter, the Joint Venture and the Park County Commissioner, after reviewing the various alternatives of mine access in and around Gardiner, collectively determined that upgrading the existing county road up Z-Hill would be the best option primarily because upgrading the road would provide a much safer route for not only mine workers, but local residents and recreationists. Upgrading the existing county road was included in the draft EIS because it was the agreement reached by the JJV and the county. The Hard Rock Mitigation Plan attached to the Joint Venture's mine permit application would either be corrected or deleted from the application.

B The decision to use the Jardine Road was made by the county and the JJV during formulation of the impact plan. There were public meetings held regarding the plan, and the road alternatives were discussed at a meeting held October 9, 1984, at 7:30 p.m. at the Gardiner School.

The JJV has formulated a plan to encourage employee car pooling and to provide bussing. When employment reaches 50 people, the JJV would provide cash incentives to employees who carpool; the amount would be based on the number of riders per car. When employment reaches 100, the cash incentives would be discontinued, however, at this point bussing would be provided by JJV from Gardiner to the minesite. Parking at the minesite would be limited to 50 employee vehicles once bussing starts. Fifty vehicle passes would be issued to employees, based on seniority. Vehicles without passes would not be allowed to park at the minesite (R.T. Agar, Vice President, American Copper and Nickel Company, pers. comm., January 22, 1986).

The JJV has designed shift changes to minimize the amount of traffic on the Jardine Road during peak use by other travelers. Day-shift traffic would occur mostly before 7:00 a.m. Afternoon-shift traffic would be heaviest before 3:45 p.m. Night-shift traffic would occur mostly between 11:00 p.m. to 12:00 a.m. Such shift scheduling would minimize conflicts with other users traveling to and from work and with school bus traffic.

LETTER 16

how hard have they worked to find a suitable alternative? Isn't there a major fault which runs right through Jardine? The question of the grade change might have some merit if there were no other factors, but there are!

What about the residents along the existing road? Their input has never been solicited or even acknowledged. From the above report, it appears we don't exist. Kit, It makes absolutely no sense to plan the main access to the mine through the residential area of Gardiner. Doesn't the County Planner consider things like that? The health and safety of the residents along the county road should carry more weight than any of the feeble excuses cited above.

C As I stated in my testimony, the area from US 89 to the Z-hill contains most of the remaining residential development land in the Gardiner area. In the next twenty years, there will be many more residences along the road, especially if the mine opens in Jardine. These same considerations should be addressed in routing the power line to Jardine.

I greatly appreciate the opportunity to comment on the EIS and mine application. As I stated in my formal testimony, I believe the settlement of these issues before the operation begins will certainly increase community support of the project. We hope that you can represent our concerns and that the Jardine Joint Venture will indeed be "good neighbors" by accepting these recommendations.

Sincerely,

Bob Gresswell

The JJV has agreed to provide $500,000 to Park County to fund improvements to the Z-Hill Road. The funds are considered tax prepayments for which the JJV would receive credits against future tax liabilities. A portion of the money ($50,000) would be used to fund a detailed engineering study on upgrading the road. Anticipated improvements include reduction of the grade, drainage control, installation of guard rails, and improvement of sight distance through curves.

If the JJV were to construct an alternate access route, Z-Hill could continue to experience mine-related traffic increases because the JJV cannot prohibit people from using Z-Hill to access the project. Furthermore, if an alternative route were constructed, Z-Hill Road would not be improved as planned in the hard-rock mining impact mitigation plan. Constructing an alternative mine access route would not negate public hazard due to traffic on Z-Hill Road. Therefore, detailed biological, geological, and engineering studies are not required to compare the benefits of access route alternatives.

McLean (1984) does not offer biological data to support his analysis. However, abundant baseline information is available. Please see the vegetation, wildlife, fisheries, and aquatic sections of Chapter II in the EIS. Building a new road would impact more wildlife habitat than would using an existing road. Alternative A would cross the Phelps Creek elk-concentration area (see figure II-12).

C Please see Chapters I and IV for discussions of the power line alternatives.

The areas on the lower end of Z-Hill and between U.S. 89 and the river north of Gardiner contain nearly equal amounts of developable land and together have most of the land near Gardiner suitable for homesites. The JJV commitment to reduce traffic to upgrade the Z-Hill Road would significantly lessen public hazard due to mine traffic. Moreover, improvements made to the Z-Hill Road would benefit all users, not just mine workers (see response to comment B); but also current and future residents along the road. Constructing an alternate access route could expose residents along Z-Hill to greater public safety risks than currently exist because mine traffic could continue to access the project via Z-Hill Road and planned improvements to the road would not be undertaken.

LETTER 16

December 3, 1985

Testimony concerning the Jardine Joint Venture Project Draft Environmental Impact Statement

My name is Bob Gresswell. My wife and I reside along the county road to Jardine, approximately 1/4 mile east of its junction with U.S. Highway 89. We will be directly impacted by the proposed Jardine Joint Venture Project. Although we support economic stability in the Gardiner community and the increased economic stability for Park County which this project may bring, we have serious doubts concerning three issues and the manner in which these issues are dealt with in the Draft Environmental Impact Statement (EIS).

The first and foremost of these concerns is the proposed access to the Joint Venture project from U.S. 89. In the Jardine Joint Venture Hard Rock Mitigation Plan, the proposed plan of action was to consider both 1) upgrading and rehabilitating the Jardine Road, and, 2) constructing a new road using existing and new right-of-ways, pending completion of an engineering analysis. In the Joint Venture operating permit application (p.11-18) it was stated that "final plans will be developed for the new construction after permit approval and prior to beginning construction." In the EIS (p. IV-1), however, the applicant proposed "to use the existing Jardine Road as access from Gardiner." Why does the proposed route differ in the EIS? Have engineering studies beeen completed? If so, why haven't the results of these studies been included in the EIS? If the studies have not been completed, when will they be completed? Why has the access road, a potentially controversial issue, been allowed separate approval and not been viewed as an integral part of the operation application?

LETTER 16

In the Mitigation Plan (p. 120) preliminary cost estimates suggested a cost of between "750,000 and $1,000,000, plus land aquisition and relocation costs" and that "road rehabilitation would be somewhat less expensive." Whatever option is chosen, the Joint Venture states they are willing to directly "procure and manage the reconstruction process." In the EIS, the applicant has agreed to pay $500,000 to Park County to upgrade the Jardine Road. Again, there has been an apparent decision made concerning the access route. Does this mean that the mine will no longer support costs above the $500,000? What improvements are to be made under this option? How much land will be required? Which land owners will be affected? Will the grade of the road be reduced? Will there be any portions paved? Will sidewalks and gutters be provided through the residential section along the lower portion of the road? Is the $500,000 actually a simple prepayment of taxes as stated in the Mitigation Plan? Why aren't these cost estimates included in the application?

Although the EIS does mention public safety as a disadvantage to the use of the existing county road, neither the mitigation plan nor the operation application mention this factor. Should visual impact be considered in the decision? Would an alternative route, such as Alternative A in the EIS, alleviate safety problems to people in the residential areas? Much of the remaining land for residential development in the Gardiner area lies along the lower portion of the county road. Will a substantial increase in the number of residences in this area be considered in the final access decision?

A second concern we have is the location of the required 69-kilovolt transmission line to be supplied by the Montana Power Company (MPC) to the

LETTER 16

Joint Venture project. When will the exact location of this line be made public? Why wasn't this included in the EIS? Since this transmission line may also be an important impact, albeit indirect, of the proposed project, should it be a part of the operation application? Does the Montana Department of State Lands have the authority to require that both the road and power line issues be addressed in the permit application?

Finally, according to the EIS (p. III-6), the project will require 0.073 cubic feet per second (cfs) of surface water; however, the Homestake Mining Company has submitted water rights claims totalling 201.6 cfs. What does the Joint Venture plan to do with the remaining 200 cfs which will not be required? Since summer flows rarely exceed 20 cfs, there is a decided potential to totally dewater Bear Creek if their priority dates pass the adjudication process. Since the claimed water is "6,000 times as much water as is need to satisfy the requirements of the proposed project", what can water users with lower priority claims expect when the mine begins operation?

It is my sincere hope that these concerns can and will be addressed prior to the Joint Venture permit approval. I believe that if these issues can be settled before the operation begins, community support of the mining project will increase greatly. It would also appear that detrimental impacts on the community of Gardiner would be reduced, and benefits, beyond those of monetary well-being would be available to a greater portion of the area's residents.

Robert E. Gresswell,Jardine Route, Box 50,Gardiner, Montana 59030

RECEIVED
DEC 16 1985
STATE LANDS

LETTER 17

The Bozeman Environmental Information Center
P. O. Box 3865
Bozeman, Montana 59715

December 9, 1985

Kit Walther, Chief
Environmental Analysis Bureau
Reclamation Division
Montana Department of State Lands
1625 11th Avenue
Helena, MT 59620

RE: Comments on the Jardine Joint Venture Draft EIS

Dear Mr. Walther:

The Bozeman Chapter of the Montana Environmental Information Center represents approximately 200 MEIC members living in Gallatin and Park counties. BEIC is a conservation and environmental advocacy organization and as such we would like to state some of our concerns about water quality which we feel should be addressed in the Jardine Joint Venture Draft EIS.

A BEIC is concerned that water quality in the Yellowstone River and Bear Creek will be degraded by the project. The toxic nature of the chemicals to be used for processing at the mine, possible leaching during mining and backfill operations, and potential seepage from the tailings dump pose a direct threat to the water quality and the fisheries of Bear Creek and the Yellowstone River as well as to the groundwater quality of the area. While the DEIS outlines a good monitoring and mitigation plan for water quality impacts (DEIS, pp. III, 11-14), enforcement of those measures is the key to successfully mitigating water quality impacts. BEIC urges the Department of State Lands and the U.S. Forest Service to diligently enforce the monitoring and mitigation measures outlined in the DEIS. All the mitigation measures suggested in the DEIS should be mandatory for any permit approval.

B BEIC is also concerned about the water rights application submitted by the mine's developers. The request is for significantly more water than the developers claim is needed for the mining operation and is more than the mean flow in Bear Creek. While it may be a common practice for water rights applicants to request more than is actually needed, BEIC is concerned

A Additional commitments by JJV to prevent environmental contamination from the mine have been made. These commitments include: 1) sending all tailings from the more-toxic, cyanide-agitation circuit to the lined impoundment, 2) lining all ditches and sumps in the mine, 3) grouting in the mine to stop the flow of water, and 4) mixing the last two feet of sand backfill with cement to create a hard, impermeable surface. Your other comments are noted, thank you.

B The Department of State Lands and the USDA Forest Service do not have jurisdiction over the adjudication of water rights claims in Montana. This responsibility lies with the Montana Water Court. Please note that while the JJV

LETTER 17

that the high volumes of water requested will dewater Bear Creek and therefore seriously impact the fishery and rights of downstream water users. BEIC urges that the project should not be granted water rights that exceed the amount needed for the operation.

C Finally, the DEIS leaves several other key water quality questions unanswered. Does the proposed plan for tailings ponds anticipate that the mine will be in operation longer than predicted? If so, what measures can be taken to insure safe and effective water quality controls for additional tailings? Will the mining be curtailed or halted in the event that monitoring identifies significant water quality problems that were not anticipated? The final EIS should address these issues.

D In conclusion, BEIC feels that the DEIS does a good job of addressing most issues that concern our members. While some negative impacts are inevitable, the DEIS states that most can be mitigated. BEIC agrees with that in principle. However, mitigation will only be as effective as the measures adopted to prevent degradation of the environment. BEIC urges you to enforce vigorously the mitigation procedures, regulations, and laws applicable to the final permit. All the monitoring should include feedback mechanisms which curtail or halt practices which cause unacceptable or illegal impacts. Only with an aggressive monitoring and mitigation program will the water, land, and wildlife of the area be adequately protected.

Sincerely,

Jerry W. Calvert
on behalf of the BEIC
board of directors

cc Rob Breazeale, Supervisor
Gallatin National Forest

has claimed 201.6 cubic feet per second in the current statewide adjudication process, they have applied for only 3.31 cubic feet per second in their application for a hard-rock mining application. If the hard-rock mining permit application were approved, it would be approved for the use of only 3.31 cubic feet per second. Montana's Prior Appropriation Doctrine would not allow downstream senior water rights holders to be affected by an upstream junior water user.

C The JJV has applied for a hard-rock mining permit that specifies a 20-year mine life. Any change in the mine plan presented in the permit application would require an amendment and additional analysis. At this point in time, no plans for expansion have been presented by the applicant.

In the event that monitoring identifies significant water quality problems, the permit could be revoked or suspended.

D Comment noted, thank you.

LETTER 18

[illegible]
P.O. BOX 1730 HELENA MONTANA 59624 • (406) 442 2405

December 13, 1985

RECEIVED
DEC 16 1985
STATE LANDS

Mr. Kit Walther
Chief, Environmental Analysis Bureau
Montana Department of State Lands
Capitol Station
Helena, MT 59620

Dear Mr. Walther:

This letter is written in support of the Jardine Joint Venture Project.

Environmental impacts of underground mining are minimal compared to other types of mining; indeed, the impacts as outlined in the draft EIS should not be a barrier to development. Sixty-seven acres, to be disturbed by the mining, is actually a very small area. We note that the removal of two historic tailings impoundments would actually result in improvements to the ground water system and Bear Creek, and that visual impact is minimal.

Perhaps one of the most significant statements in the draft EIS is, "Mine employment would add $3.4 million annually to Park County income... Secondary job increases would add between $359,936 to $506,160 to total county income." In a state beset by economic woes, in a county that has just suffered a severe blow, this would be the best news of the decade.

Montana is a natural resource state and our best hope for a stable economy depends on development of those natural resources. Approval of the Jardine Joint Venture would be an important act for the citizens of Park County and of Montana.

Sincerely,

FHBoles

Forrest H. Boles
President

FHB/ssg

Comment noted, thank you.

LETTER 19

Montana Department
of
Fish, Wildlife & Parks

Helena, MT 59620
December 12, 1985

RECEIVED
DEC 16 1985
STATE LANDS

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Montana Department of State Lands
Capitol Station
Helena, MT 59620

Dear Kit:

The Department of Fish, Wildlife and Parks has reviewed the Draft Environmental Impact Statement for the Jardine Joint Venture Project. While we believe that this is a well-planned project (and well-prepared EIS), we have a number of concerns. In particular our concerns focus on both the short and long range risk of locating a major tailings deposit near the headwaters of the Yellowstone River and with the cumulative impacts of this activity on other valued elements of the greater Yellowstone ecosystem. I am sure you understand that the extensive wildlife and fishery values of the area cause us to have a greater level of concern than we would in many other areas. Our specific comments follow:

A p. I-4. According to the report, tailings are particularly high in arsenopyrite. The Yellowstone River, as it leaves Yellowstone Park, is naturally high in arsenic due to geothermal activity within the Park. High arsenic concentrations pose a threat to aquatic life, but of ever greater concern are the carcinogenic properties of arsenic. According to federal criteria, virtually any increase in arsenic in drinking water increases the risk of cancer. Both the processing and containment of the tailings appear to be reasonably well planned. Nevertheless, the tailings liner and cap have finite lifetimes. We are concerned that at some future time these materials will be subject to leaching and erosion.

B p. I-10. We are concerned that the seepage pond, which is not scheduled for reclamation, could be vulnerable to erosion at some point in the future. We would like to know what steps are being taken to assure the long-term stability of this structure.

C p. I-11. The EIS fails to describe the monitoring plan in any detail; for example parameters to be measured are not listed in the text. The only information provided is that surface water will be sampled quarterly both upstream from and downstream of the mining operations. This may be adequate for some parameters but not for others. We suggest picking one or two common ions that would normally concentrate in mine process water (e.g. potassium, if potassium anyl xanthate is being used as a milling reagent or possibly nitrate which is a normal residue from explosives used in mining) and to monitor these parameters daily. Quarterly

A DSL agrees that both the processing and containment of tailings are reasonably well planned. The method of disposing a "dry" (15 percent moisture) tailings on a double-lined system which incorporates an underdrain to effectively reduce hydraulic gradients across the liner is considered to be "state of the art." Assuming the tailings liner and cap have finite lifetimes, a small amount of recharge to the facility might occur through cracks, fissures, or depressions in the surface. The amount of percolation would depend largely on the degree of failure. Neither can be predicted accurately. However, note that the hydrology summary of Chapter III states:

> Two historic tailings impoundments would be removed and placed within the proposed tailings dump. This action would result in a decrease in the loading of cyanide, arsenic, and other heavy metals to the ground water system and Bear Creek.

Therefore, a value judgement must be made. The proposed project would eliminate an existing and well-documented environmental hazard in an effort to protect the environment and safeguard public health at the risk of having to solve a less significant problem at some undetermined time in the future. Furthermore, problems related to breaches in the integrity of the clay cap are easily correctable, and the surface can be reclaimed if necessary.

B Please refer to page III-14 of the draft EIS which states:

> After all residual solutions have drained from the tailings, both the seepage collection pond and return water pond should be filled with bank material and reclaimed.

C Please refer to Chapter III--Hydrology, Surface Water of the EIS, which, in fact, lists the monitoring plan in detail.

Also, please refer to Appendix 15 which presents the updated hydrologic monitoring plan.

LETTER 19

monitoring is simply not often enough to detect short term changes. It would also be advisable to plan the quarterly monitoring periods to coincide with spring snowmelt and also with a summer thunderstorm. These are times when mining wastes might be expected to wash into Bear Creek.

D p. III-5. We acknowledge the benefit of moving historic tailings deposits into the new impondment. Nevertheless, there may continue to be long-term risks involved, even in the new location. For example an earthquake could rupture the clay and membrane liner and result in liquification or piping of the stored tailings into Bear Creek. It would be helpful to have an opportunity to review the success of similar tailings impondments elsewhere.

E p. III-6. Figures shown in table III-1 indicate that baseline sediment yield at the mine site would cause nearly an 85-fold increase in sediment yield to Bear Creek and a 49-fold increase to the Yellowstone River. We already are experiencing serious sediment problems in the area that have threatened the livelihood of local outfitters. Additional sources of sediment to the Yellowstone River will not be viewed favorably.

F p. III-11. The argument is presented that acid drainage will not occur because the highest previous detectable groundwater was 62 feet below the proposed mine. However, we continue to be concerned that groundwater might be detected at higher elevations once mining begins. A contingency plan should be developed to prevent acid drainage waters, under any circumstances, from entering the Yellowstone River.

G p. III-15. The EIS acknowledges that seepage rates exceeding 22 gpm would adversely impact Bear Creek if they were to occur and further that the probability and magnitude of such an impact cannot be reliably predicted. The Department is uneasy over this uncertainty given that the mine is located near the headwaters of one of the finest trout streams in the country.

H p. III-15. Webster et al 1983 is cited concerning sediment impacts on streams but this reference is absent from the bibliography.

I p. III-16. Total suspended sediment concentrations are predicted to reach 140 mg/l during project construction. This is an extremely high suspended sediment concentration and is within the range that would not be expected to support a good fishery according to Newport and Moyer (1974) -- a reference cited in the text. As pointed out earlier, the Yellowstone River is already experiencing high turbidity during some years, originating from natural sources within Yellowstone Park. This turbidity is already decreasing the fishability of the river during the favored fishing months of July-September.

J Rupture and leakage of tailings pipelines has been a serious problem at the ASARCO - Troy facility. On at least two occasions leakage has resulted in tailings entering a drainage in the area. Similar problems could conceivably occur in the harsher climate of Jardine. We recommend suspending the pipeline above a lined ditch that will funnel spilled tailings back into the tailings

D Rupture of the liner under the tailings dump is a remote possibility. However, even if the integrity of the liner were compromised in one area, the amount of moisture passing through the tailings would be so small that adverse water quality changes would not occur (also see letter 13, comment M and our response). The tailings would not be subject to liquifaction because they would be deposited in the dump at moisture levels well below saturation by means of a dewatering system (see Appendix 19). Also, the clay cap on top of the mound would preclude saturation of the tailings.

E Please refer to the response to letter 6, comment A.

F If water is encountered in the mine, JJV has committed to the following contingency plan:

a. Water encountered by diamond drill holes - When drill holes encounter water, they would be grouted with quick-setting cement to stop the water flow from the hole.

b. Water encountered in mine opening - Water in the mine can be the result of (1) tapping the water table; (2) tapping a fault that contains water derived from the surface; and, (3) tapping perched water tables. In the case of (1) and (2) above, depending on the volume of water leaking into the mine opening, the area of leakage would be curtain grouted to seal off the water table. In the case of (3), the water would run for a few hours and dry up. If it did not dry up, the grouting procedure could be implemented.

c. Water pumped into the mine - In this case, the sandfill slurry is pumped into a stoping area to provide support and eliminate the possibility of caving. The sandfill is allowed to drain with the water collected in underground ditches and sumps. This water is then recycled for drilling purposes, dust control, or returned to the mill. Sumps are lined to prevent seepage. Sludge normally collects over the liner to form a permanent seal. The same would apply to the ditches. Because the mine openings are sealed with grouting, backfill and drilling water are effectively sealed off from the ground water system.

G Please refer to the responses to letter 17, comment A; letter 19, comment F; and the explanation of cut-and-fill mining presented in Chapter I. These commitments would significantly decrease mine flow through. Furthermore, the JJV has committed to disposing of all of the tailings from the cyanide agitation circuit to the lined tailings impoundment.

LETTER 19

H Comment noted. The reference has been added to References Cited in the final EIS.

I Please refer to the response to letter 6, comment A.

J Please refer to design details presented in Appendix 21 regarding tailings line ditches.

The JJV has committed to install an automatic slurry/return water pipeline system (see chapter I and response to comment K).

LETTER 19

impondment. Every precaution should be taken to prevent tailings from entering Bear Creek and subsequently the Yellowstone River.

K We are concerned that nutrients from the drain field could enter Bear Creek and result in enrichment of the creek. Bear Creek is one of only a few cutthroat spawning tributaries in the upper Yellowstone River and a major spawning area is present downstream of Jardine. Excessive algal growth could decrease gravel permeability and result in lower than normal oxygen conditions in the intergravel environment. Alternatives to a drain field, such as adding sewage to the recycled water supply, should be considered.

L A small amount of information is present in the Appendix concerning the toxicity of milling reagents. We appreciate the attempt to describe toxicity of these compounds; however, we would much prefer a more detailed literature review and discussion of toxicities and potential hazards. Toxicity of milling reagents is a common concern raised during almost all new mine operation plans. It seems to us that such a review could be used repeatedly in the future.

M In general, we agree that the direct impacts of the proposal on wildlife habitats and populations would be minor. However, the potential indirect impacts are of more concern.

The County Road Alternative A would cross important late winter range for elk. For that reason, we support the proposed route.

N Since the tailings at Jardine are known to be high in arsenic, the deer and elk proof fence should be constructed around the tailings pond at the onset--before any problems are discovered. Experiences at several tailings disposal sites near other mines in western Montana have demonstrated that animals may be attracted to these sites which may result in heavy metal poisoning.

O As an additional mitigating measure, the land trade proposal wherein the Forest Service would acquire private lands on Deckard Flats should be pursued. This would prevent residental development on Deckard Flats.

P Specific wildlife related comments are as follows. One page II-32, it should be stated that the initiation of elk migration is variable from year to year, rather than implying that different studies have found conflicting results.

Thank you for the opportunity to comment.

Sincerely,

Robert R. Martinka
Resource Assessment Unit

RM/bl

cc: Leroy Ellig
    Glenn Phillips
012/13

K The applicant has committed to constructing ditches 2 feet by 2 feet, including retention ponds beneath all slurry/return water pipelines to assure that offsite losses of tailings would never occur. In addition, the applicant has committed to implement a number of design features to minimize the chances of pipeline failure, and an automatic shut-off control system in case of failure (see Chapter II).

Eutrophication of Bear Creek is not predicted in the EIS. Please refer to Chapter III--Hydrology, Surface Water and to the response to letter 6, comment D.

L Appendix 22 presents additional information regarding the toxicity of milling reagents.

M Comment noted, thank you.

N Please see letter 20, response JJ and the revised text.

O Completing the land trade is a priority goal of the Gardiner Ranger District. The district plans to manage the Deckard Flats portion for wildlife (L. Lewis, U.S. Forest Service, pers. comm., January 31, 1986).

P The final EIS contains minor text revisions.

LETTER 20

United States Department of the Interior

OFFICE OF THE SECRETARY
OFFICE OF ENVIRONMENTAL PROJECT REVIEW
Denver Federal Center, Building 67, Room 488
P.O. Box 25007
Denver, Colorado 80225-0007

December 12, 1985

ER 85/1630

RECEIVED
DEC 16 1985
STATE LANDS

Kit Walther, Chief
Environmental Analysis Bureau
Montana Department of State Lands
Capitol Station
Helena, Montana 59620

Dear Mr. Walther:

This is in response to the request for the Department of the Interior's comments on the draft Environmental Impact Statement (EIS) for the Jardine Joint Venture Project, Park County, Montana.

General

The rise in interest in the greater Yellowstone area as a single ecological unit has had an effect on land management in the area. It is no longer possible for managers in any agency to think only of the local consequences of their management actions. Yellowstone National Park is located only three miles south of the project and a principal concern is that the proposed project in no way diminish the values for which Yellowstone National Park is being preserved. But the broader perspective is equally important now, because whatever happens outside the park has certain effects in the park.

A The Jardine Joint Venture Project is a good example of this situation. It is a controlled, small-acreage development, apparently with very limited resource needs. It has the potential of being of great value to Park County, and the applicant has displayed considerable sympathy with the special conditions required for safe commercial development in this area. But for all the potential advantages of the project, there are potential risks. We do not believe that the draft EIS has addressed these risks with sufficient firmness, and question whether any combination of commitment and mitigation can entirely eliminate the risk we see as most potentially harmful, that of the loss of additional grizzly bears from an already declining population.

For the most part, the EIS takes the narrow view of cumulative effects. Most discussions of cumulative effects deal only in the cumulative effects of the mine in concert with logging near the Jardine area. The "Cumulative Effects Model" developed by the Interagency Grizzly Bear Committee in 1984 takes a broader view then that, and we believe that especially in the case of the grizzly bear such a view must be taken with the Jardine Joint Venture Project.

The Jardine Joint Venture Project is only one of many developments on the horizon for the Yellowstone area. Some are infinitely larger and more threatening to the wholeness of the ecosystem, some are much smaller, but it is no longer possible to measure any one of them solely on its own merits. The EIS does not address the Jardine Joint Venture in this greater context, but instead focuses on local effects in the Gardiner area.

A We feel the environmental risks posed by the project are clearly identified in the draft. Expecting commitments and mitigations to "entirely" eliminate all risks is not realistic. Rather, the mitigations are designed to reduce risks to an acceptable level.

The rationale behind the cumulative effects discussion is explained in letter 26, response A. Because logging is the primary activity scheduled for the assessment areas, it was the focus of the discussion. The computerized Cumulative Effects Analysis (CEA) model for the Yellowstone area would be available at some point in the future. The permitting agencies do not have the option of waiting for the completed CEA model.

B Details regarding Enco's application for a preliminary hydropower permit from the Federal Energy Regulatory Commission are reproduced as Appendix 17. A preliminary permit does not authorize construction. However, it does allow the applicant to proceed with feasibility studies by obtaining site control.

DSL has been in contact with Mr. Kenneth R. Koch, Enco Development Corporation regarding the status of this project (pers. comm., January 20, 1986).

LETTER 20

The following comments are directed at specific points where we think the EIS needs revision or strengthening. Our overriding concern is that all possible caution be exercised in caring for the resources near the project as well as those throughout the Yellowstone area.

B We have also recently become aware of an application by Enco Development Corporation, Bellingham, Washington, for a preliminary permit to study the feasibility of hydropower production on Bear Creek within the Jardine Joint Venture Project area. Changes, if any, resulting from development of this project on impacts described in the DEIS should be documented in the FEIS. Of concern are cumulative impacts from development of both projects and particularly any additional impacts occurring as a result of additional dewatering of Bear Creek.

Description of the Proposal

C Please explain open cut-and-fill stoping discussed on page I-2. Open stoping and cut-and-fill stoping are easily understood, but open cut-and-fill stoping is not a method used in any mines that we know.

D Explain why development of additional ore reserves below the 1,050-foot level would require additional permitting as stated on page I-2. What mineral resources are believed to exist below and immediately surrounding the proposed mine, and what effect is the proposed mine likely to have on future utilization of these resources?

E The first sentence on page I-4 says the ore is crushed to expose the sulfide minerals. Montana Memoir No. 23 (Montana Bureau of Mines, State of Montana) and personal communication with an employee of the former Jardine operaton indicate the bulk of the gold was free milling. How much of the gold is free milling, and how much is contained in sulfides? Not only is the gold indicated to be free milling, but on page II-3 of the DEIS, as well as other sources, the gold is known to occur in nugget form in addition to fine disseminated gold. How will the outlined circuit handle the coarse gold since flotation is not applicable to this type of ore?

F On page I-4, last sentence, the bulk float tailings should be differentiated from the cyanide tailings. Constituents of both tailings should be outlined, and then the disposition of each tailings specifically detailed. A schematic diagram of this would be very helpful.

G What size fractions of the tails will be used for backfill and the tailings pile? What will be the percentage of solids in the slurry? Will cement be used in the fill?

H On page I-5, the document states that the tails will be dried using a "belt filter." We have no knowledge of any equipment of this kind. Please send copies of technical data on this equipment or the manufacturer's address to Rob McCullough, Minerals Involvement Section, Branch of Engineering Studies, Bureau of Mines, Western Field Operation Center, East 360 3rd Avenue, Spokane, Washington 99202.

I Will the tungsten in the ore be recovered by the planned mill? How much gold, silver, tungsten, and other minerals are expected to remain within the tailings? What is the grade of the old tails? What minerals are planned to be recovered through remilling of the old tails before emplacement onto the new site?

Mr. Koch stated that plans for development of FERC project P-2832-000 are presently on hold. According to Mr. Koch, Enco Development Corporation would "work in tandum with Jardine Joint Venture" exchanging water rights for electricity if future studies proved this project to be economically feasible.

However, Mr. Koch indicated that recent tax law changes affecting small-scale hydropower operations would most likely render this project financially infeasible.

Assuming 880 feet of operating head (Kenneth R. Koch, Enco, pers. comm., January 20, 1986), a 400-kV plant would require less than 10 cubic feet per second of flow.

C Open cut-and-fill mining is used at Homestake's Lead, South Dakota operation and by Cyprus Mines Corporation's Bagdad, Arizona operation. Open cut-and-fill methods are used primarily for grade control and ground control. This method permits selective mining of the ore so the waste can be left in the stope. Refer to Hustrulid (1982) for a detailed description.

D The Jardine Joint Venture permit application states that mining would cease at the 1,050-foot level. If the JJV plans to expand the mine below this level, the permit would have to be amended. Ore exists below the 1,050-foot level west of the Bear Creek fault and could be mined if future prices warrant such expansion (see figure II-2).

The Joint Venture also owns or leases claims covering the historic mining area of Crevasse Mountain (see figure I-1); however, the agencies have no knowledge of the economic or environmental viability of this area. Development at this site or any other outside Mineral Hill would require separate exploration and mining permits from the USDA Forest Service and the Department of State Lands.

E Pilot mill tests on the ore indicate that 97 percent of the gold would go through the sulfide concentrate circuit for further treatment with cyanide. The JJV adds that "the mill will contain a series of jigs over which the mill feed will be passed prior to sulfide flotation. In the event that free gold is encountered, this gold would report at the jigs," (R.T. Agar, Vice President, American Copper and Nickel Company, Inc., pers. comm., January 23, 1986). Ore from the mine would contain minor amounts of free gold, some nugget sized, as indicated in the geology section in Chapter II.

F The Joint Venture had samples of ore from the mine analyzed in order to characterize the chemical make up of the ore and mill process products (bulk flotation and cyanide concentrate circuits). The results of the test are presented in Appendix 1. Only bulk-float tailings would be disposed of within the mine. Most of the heavy metals and sulfides would be removed from the bulk float tailings. All of the cyanide-circuit tailings would be placed in the sealed tailings dump.

LETTER 20

G The bulk flotation tailings produced by the mill would be expected to have the following properties:

80 percent passing no. 200 sieve (0.074 mm)
65 percent passing no. 400 sieve (0.037 mm)
8 percent smaller than 2 microns (0.002 mm)

The bulk float tailings would be sent to either the tailings disposal dump or back to the mine and would not change in gradation. The cyanide-circuit tailings would probably be finer than the bulk flotation tailings described above.

The JJV estimates that the bulk float tailings slurry would be about 60 percent liquid by weight. At the tailings disposal dump, most of the slurry water would be removed, lowering the water content of the tailings to about 15 percent by weight. The tailings placed into the mine would initially contain 60 percent water, but would drain, eventually reaching an unsaturated state of less than about 30 percent moisture by weight.

The JJV's operating plan indicates that cement would be incorporated into the top layer of each backfill lift to provide a platform for miners to stand on (see revised Chapter I).

H We have sent an 11-page document to Rob McCullough which discusses the various methods that could be used to dewater tailings produced at this mine. The text to which you refer has been slightly changed.

I Tungsten would not be recovered by the mill circuit as presently designed. Appendix J-2 indicates the contents of the tailings from the bulk flotation and cyanide leach circuits. Gold and silver values are considered proprietary information and were not submitted by the JJV. Mill testing to date indicates the old tailings would contain about 0.014 ounces of gold per ton. If the old tailings are remilled, gold is the only mineral of economic value likely to be recovered (R.T. Agar, Vice President, American Copper and Nickel Company, Inc., pers. comm., January 22, 1986).

LETTER 20

Mr. Kit Walther

J Has the tailings disposal area been drilled to determine if mineral deposits exist under the proposed site? What values, if any, were found, and how will they be affected by the proposed project?

K Montana Memoir No. 23 and Bureau of Mines records indicate extensive placer deposits adjacent to the planned project. How will these be affected by the project?

L We support the applicant's proposal to utilize the existing Jardine Road for mine access, provided a mandatory busing system for mine employees is implemented.

M The map on page I-3 does not sufficiently place the project area in geographical context with either Yellowstone Park or Absaroka Beartooth Wilderness boundaries.

Geology

N The discussion of the geology and hydrology should include information on the frequency, trends, and characteristics of rock joints in the project vicinity.

O On page II-5, it would be useful if the EIS provided a recurrence interval for earthquakes of magnitude 5 and 6 in the Gardiner-Jardine area.

P A section of the EIS should address the potential beneficial and adverse effects that this project may have on mineral resources of the surrounding area. Areas this plant could beneficially affect would be Crevice Mountain, Oregon Peak, and upper Pine Creek, as outlined in U.S. Geological Survey Bulletin 1391-B, Absaroka Primitive Area, Montana.

Hydrology

Q There appears to be a mathematical error on page IV of the "Summary", and page III-5 under "Hydrology." It is stated that 0.073 cfs withdrawal would deplete Bear Creek by a factor of 0.5 percent during periods of low flow. On page II-8, low flow (which occurs in February) is said to be 12.5 cfs. 0.073 is 0.58 percent of 12.5.

R Regarding water quality in the Yellowstone River bordering the Park downstream from the mouth of Bear Creek, we are generally concerned with the tentative and conjectural nature of most discussions of the damage risk mitigation, but will point out a few specifics. In this case, under "Water Use and Management" (page I-7), the EIS states:

> If the recycled water is high in total dissolved solids, two sludge ponds may be constructed between the embankment and the seepage collection pond. The water could then be treated to precipitate the dissolved solids before the water is returned to the mill.

We realize that this is recycled water, being reused by the mill, but the language is still problematic. How is "high in dissolved solids" to be defined? Will a certain level of dissolved solids require the construction of sludge ponds?.

S As we read Table II-3 (page II-9), it appears that mining claims alone could account for almost 1,000 percent of Bear Creek at low flow. It is imperative that the applicant assure that Bear Creek will not be dewatered by the project.

J Bedrock was encountered in well no. 4 at 340 feet, well no. 5 at 240 feet, well no. 7 at 370 feet, and well no. 8 at 130 feet (see figure II-6). Well logs indicated bedrock was the same (quartz biotite schist) as that found in Mineral Hill. Geochemical data and geologic information so far give no indication of the mineralization below the proposed tailings dump. Construction of the tailings disposal dump would not interfere with future mineral development under the area.

K A few small placer excavations exist along the streambank of Bear Creek downstream of Jardine; however, the large terrace adjacent to Jardine and the proposed tailings dump site do not appear to have been mined for placer gold. Environmental concerns such as proximity to Bear Creek and the great depth to bedrock are strong negative deterrents to placer gold mining of the terrace.

L The JJV would provide free bussing from Gardiner to Jardine once project employment reaches 100 people. The JJV would also encourage carpools by paying cash incentives to drivers based on the number of passengers in their cars when employment reaches 50 to 100 people. When bussing is provided, 50 passes to park at the project site would be issued. Workers must have a car pass in order to be admitted to the project by the security guard.

M The Yellowstone National Park boundary is noted on the figure.

N Mapping of bedrock geology of Mineral Hill indicates the area underwent at least three major periods of compression resulting in a complex folding pattern of the Mineral Hill strata (see figure II-2, which depicts a cross-sectional view through Mineral Hill). Orientation of bedrock jointing is quite varied as a result of the varied tectonic forces that affected the site over the last 3 billion years. The applicant indicated that roughly 1 to 5 percent (average 2 percent) of the core rock recovered from the mine was fractured, but gave no indication of the amount of continuity that could be expected. More information regarding jointing and fracture patterns may be obtained from Olin Hart (Jardine Joint Venture Geologist, Jardine, Montana).

O Appendix 6 in both the draft and final EIS presents the recurrence frequencies and degree of ground motion associated with various intensity ground shaking at Jardine. These values are for the mine site and take into account the probability of occurrence and strength of earthquakes within 120 miles of the site and the attenuation of the earthquake energy.

P The Jardine Joint Venture could increase, decrease, or not affect the potential for development of areas outside Mineral Hill. For example, the JJV's mine could increase the economic viability of other mineralized areas in the vicinity because the mill and office buildings are in place (that is, the support facilities for the mine could be kept running after the mineral resources of Mineral Hill are exhausted). Conversely, the Joint Venture's proposal could decrease the likelihood of additional development. The flat terrace adjacent to the mine is one of the few places in the Bear Creek Valley for tailings disposal and would be unavailable for other developments. And finally, development of the Jardine Joint Venture proposal may have no affect on the potential for development of other ore bodies.

LETTER 20

Without specific plans regarding development potential, we cannot speculate about the economic or environmental significance of mineralized areas in the Bear Creek drainage. The range of effects is too broad and uncertainties too great to allow us to provide meaningful information and assessments. Development work outside Mineral Hill would require additional permitting and environmental reviews.

Q The comment "low flow (which occurs in February) is said to be 12.5 cfs" is not accurate. Page II-8 states that the mean monthly discharge in February was estimated to be 12.5 cfs. Table II-2 also indicates that the average standard error of this estimate equals 100 percent. In regard to this relatively large standard error, the agencies question the validity of reporting two significant figures.

R Sludge pond placement and design are present in Appendix 16. The necessity for construction of the two sludge ponds would be determined either during final design or during project operation. The actual concentration of dissolved solids requiring the construction of the two sludge ponds would depend on results of testing to determine critical levels which chemically interfere with the bulk flotation circuit. If constructed, the sludge ponds would be lined with reinforced concrete. No additional environmental impacts have been predicted.

S Please refer to the response to letter 17, comment B.

LETTER 20

T Some attempt should be made to estimate the amount of arsenic naturally occurring in the water prior to mining (see page II-18).

The following comments refer to pages III 6-9:

U - What are the consequences for mine operation if the Montana Water Court assigns the project a post-1978 priority date? This eventually would, according to page II-6, "preclude further depletion of Bear Creek at least eight out of ten years."

V - We are seriously concerned about the welfare of the fish populations in Bear Creek. Bear Creek is of particular importance to the Yellowstone ecosystem because it is one of a few upper Yellowstone River tributaries that still supports a relatively substantial spawning run of cutthroat trout from the main stem river. The Yellowstone cutthroat trout, which is classified as a species of "special concern" in Montana, is native to the State. However, it now occurs only in a portion of its original range at a fraction of its former abundance. A significant factor in the cutthroat's decline in the upper Yellowstone River is the complete diversion of most major spawning tributaries for irrigation purposes after spring runoff, leaving only a few that are suitable for maintaining spawning runs. Bear Creek is one of the few.

W - The EIS should address the potential effects of siltation on egg survival in the stream. The effects of siltation on eggs is well documented, and there must be assurance that the applicant will not risk harming the eggs of any year, even the year of heaviest construction.

X - Brown trout are known to use the Gardiner River and Reese Creek for fall spawning. The EIS does not address potential impacts on possible runs of brown trout in Bear Creek.

Y - There is considerable current concern over levels of sediment in the Yellowstone River. The National Park Service is lead agency for a joint study among Federal and State agencies and conservation organizations now underway to evaluate sediment levels and sources from within the park downstream to Livingston, Montana. The high levels of sediment yield projected by Table III-1 for the first year of the project may disrupt the gathering of baseline data by the current study to some extent, though the study will also provide a means of monitoring them. It appears to us, in any event, that the timing of these high levels the first year will have a great deal to do with whether or not they become a problem downstream. A review of peak recreational use of the river might be in order to determine if the construction work that will cause the sediment can be scheduled to reduce conflicts as much as possible. Fisherman are especially concerned about siltation levels between Gardiner and Livingston.

Z - In the final sentence of the first paragraph (page III-7), it is true that prevailing weather conditions cannot be controlled, and it is equally true that erosion control practices can. It would seem appropriate that in advance of the approval of the EIS, specific erosion control practices be outlined, and the conditions under which they will be implemented be stipulated. In the third paragraph (page III-7), we read that "Properly constructed, the septic tank drainfield system would have minimal water quality impacts to Bear Creek." We feel proper construction should be defined and required.

T Table II-9 of the EIS presents maximum recorded concentrations of selected ground water quality constituents at the proposed tailings site, mill site and downgradient of the existing historic tailings. The data presented in this table establish baseline ground water quality. Baseline surface water concentrations of arsenic are presented in table II-6. The draft EIS states that the USGS reports that natural sources from thermal activity within and near Yellowstone National Park are responsible for elevated arsenic levels. There are no active thermal areas which have been reported in the vicinity of the proposed project.

U If the Montana Water Court assigns the JJV project a post-1978 priority date, JJV could, on the average, divert Bear Creek surface water only 2 out of 10 years. An alternative source of makeup water would be needed 8 out of 10 years, on the average.

V Please refer to letter 17, comment B and the discussion regarding water availability in Chapter III--Hydrology, Surface Water.

Small reductions in flow caused by the mine would not significantly affect cutthroat trout residing or spawning in Bear Creek. Please see the revised text, appendix 25, and response U.

W The effects of siltation on rainbow x cutthroat spawning are discussed in the Fisheries section of Chapter III. Effects on cutthroat would be similar.

Please refer to the response to letter 6, comment A.

X Brown trout spawning in Bear Creek was not documented during baseline surveys. The Montana Department of Fish, Wildlife and Parks electrofished lower Bear Creek during October and November of 1981. (Oswald in project application, 1984). Only resident brown trout were collected. Yellowstone River brown trout apparently spawn in creeks with lower gradients than that of Bear Creek (Berg, 1975).

Y Please refer to the response to letter 6, comment A and letter 13, comment S-3.

Z Comments noted. Specific land, soil, and water conservation practices to control erosion are presented in Appendix 14. Final design of the septic tank drainfield system would be reviewed and approved by the Montana Department of Health and Environmental Sciences.

LETTER 20

The following comments refer to pages III 12-14:

AA - We suggest that the various mitigating measures listed must become part of the final permit conditions. For instance, in the first one listed, which reads in part "Water in sediment ponds at the mine site should be used as irrigation water in reclamation and for dust suppression," this action should become a condition of approval of the permit. The second set of measures involve road impacts, which, we read, "can be mitigated." In every case where a mitigation measure is suggested, it should be required when the circumstance for its use arises.

BB - Potential erosion associated with the construction of the new powerline should also be addressed. In the sixth mitigating measure, it would be useful for readers to know more about the "special designs" in question.

CC - Examination of Figure II-6 on page II-19 and Figure III-3 on page III-3, suggests that a monitoring well should be located at the low point of the tributary thalweg a short distance southwest of the proposed tailings dump. A well at that location should intercept the probably course of pollutants from the tailings. The final EIS should include a discussion of proposed groundwater monitoring, including planned well locations.

Aquatics

The following comments refer to page III-15:

DD - In the first paragraph, it appears that there is some danger of seepage affecting aquatic life below the project. If the seepage rate could conceivably exceed 22 gallons per minute, and if the probability and magnitude of damage cannot be reliably predicted, then it seems that the seepage control system discussed on page III-10 must be installed.

EE - We would like to see documentation for the statement in the third paragraph that "an increase in TSS would affect nearly all insect taxa equally."

FF - In the next paragraph, we urge that mitigating measures which will be inplemented be clearly spelled out.

Soils

GG On page III-21, under the title of "Tailings Dump," aluminum and arsenic are identified as two elements of environmental concern. In paragraph I (last two sentences) arsenic is identified as being in the form of arsenopyrite, which is not easily weathered and is not readily available to plants and the environment. What form is the aluminum in, and what is its availability to plants and the environment?

Wildlife

HH The conclusion on the final paragraph of the elk discussion (page III-33) should be more specific. A great deal is known about social behavior and densities of elk. Is it not possible to quantify, or at least estimate, elk losses?

AA Comments noted, thank you.

BB Accurate quantification of sediment loading due to the construction of the proposed power line is not possible. However, in constructing the power line, Best Management Practices (BMP) to control erosion would be employed. These practices are outlined in Appendix 14.

Materials under consideration for use in constructing the slurry and return water pipelines include a polyurethane pipe. This type of pipe is manufactured by DuPont, under the trade name of "SCLAIR." This pipe is flexible and virtually resistant to corrosion or abrasion. It would withstand pressures up to 300 psi.

The polyurethane-type pipe described above is flexible, and capable of withstanding a significant seismic event. Pipes up to three feet in diameter of this material are currently being used by ACNC's parent company (INCO Ltd.) at its various mine and mill facilities.

"Failsafe" type controls that can be used to substantially reduce the potential for spillage from the slurry and backfill lines include:

a. Specialty piping for strength and corrosion resistance.
b. Check valves to reduce static head pressures on slopes that would limit spill volumes.
c. Electrically actuated control valves to stop slurry flow and minimize spillage.
d. Pressure-sensitive or mechanical-flow meters to monitor remote pipeline flow conditions and trigger pump/valve emergency shutdown.
e. Solid-state electronic controlling and monitoring hardware.

CC Appendix 15 presents the updated hydrologic monitoring plan.

DD Please refer to letter 19, response G.

EE Please refer to studies by Gammon (1970) and Ingman, et al. (1984). The citations are included in the final EIS (see Literature Cited and Chapter I).

FF Please refer to Chapter I--the Preferred Alternative.

GG The aluminum values given in the discussion that you reference are water-soluble values, and, depending on the pH of the tailings, all of the water-soluble aluminum could be available to plants. However, for the reasons given in the discussion in Chapter III of the EIS, plant toxicity problems are not anticipated (see Soils, Tailings Dump).

LETTER 20

II The listed mitigating measures (pages III-37 and 38) proposed by the applicant are good ones. However, as indicated, they will probably not eliminate the problem of poaching. The mitigating measures should include that the National Park Service in Yellowstone has certain educational and public relations resources that can be committed to improving this situation further, before it becomes necessary for our law enforcement resources to become involved. The National Park Service offers to set up a program of orientation, which could include such things as talks by park managers and interpreters, provision of publications to new area residents, and a long-term communication effort with the applicant to monitor other possible roles the park staff could play in helping newcomers adjust to, and understand, the area. The park has a film library and a sizeable research library that could be of use in these cooperative programs. This proposal is for possible activities separate from the already existing recreational programs, of course, and its aim is primarily education.

JJ A monitoring program for toxicity problems would have scientific values beyond the obvious safety values; the applicant may wish to explore possibilities for some kind of agency funding to help support that monitoring program. Fencing of the tailings pond should be considered as a standard mitigating technique and not be dependent upon demonstrated poisoning of deer and elk, which may be quite costly and difficult to determine. Mitigation measures should be spelled out in the final EIS as specific commitments or requirements.

KK Threatened and Endangered Species

The following discussion refers to pages III 39-43:

- The discussion of grizzly bears notes the probability of increased grizzly-human encounters, and the subsequent chance of grizzly bears being removed from the population. As was nicely summarized on pages II-46-53, the entire project area is in high density grizzly bear habitat, and has been the site of a relatively high number of grizzly bear mortalities. As was not summarized, the grizzly bear population is currently described as declining.
- The EIS does acknowledge at various points that the bear population cannot be stressed without risk. We cannot over emphasize the magnitude of those risks. Unlike the elk or deer, there are no tolerances of "insignificant impact" when a grizzly bear is killed.
- The key element of the population is adult females, of which the population cannot afford to lose any. Annual losses have frequently been too high, from a number of causes, in the past years. For those reasons we are disturbed by many of the tentative and vague statements on pages III 39-41.
- As in earlier sections, the mitigating measures listed for endangered species are appropriate, but there is no requirement to take all possible steps to prevent harm to resident endangered species. All the suggestions given in the mitigating measures section are excellent. Monitoring the tailings, reducing road kills, strict disciplinary measures against employees by the applicant, and bear-proof garbage containers are all measures that will help. They all should be required.

HH The mobility of elk and the complexities of competition make any quantitative estimate highly speculative.

II Comment noted. However, the Montana Department of Fish Wildlife & Parks and the U.S. Forest Service are responsible for conservation education outside of Yellowstone National Park. Both agencies have adequate education programs that inform the public of game laws and the effects of wildlife harassment. Introduction of the JJV project would not diminish the capabilities of these programs in the Gardiner area.

JJ Seeking funds for additional monitoring would be at the applicant's discretion. Immediate fencing of the tailings dump is not the best course of action for this project. Chapter III--Wildlife of the EIS notes the unknown factors that raise questions regarding the need for fencing. Furthermore, the dump would be reclaimed during mining and deer and elk may avoid the dump site.

A significant barrier should not be placed in an elk migration route until its need can be clearly demonstrated. For this reason, the permitting agencies prefer to more closely examine the potential for poisoning before requiring fencing around the dump. Fencing would not depend only on demonstrated poisoning. Animal use of the tailings dump area would also serve as a criterion for fencing. Please see the final EIS for the applicant's monitoring proposal. Note that fencing the seepage-collection pond is now proposed and fencing the return-water ponds would be required immediately. The importance of water to deer and elk is much more established than is the attractiveness of tailings. The small size of the fenced ponds would not interfere with elk migrations.

KK Knight and Eberhardt (1985) stated: "While the trend in time cannot be established with certainty, there are, . . . various grounds to believe that the population may be declining." The revised Chapter II mentions their evaluation. Please note that the EIS implies a population decline by noting the unfavorable death-to-birth ratio (see Chapter III--Threatened and Endangered Species).

Comment noted, thank you.

We agree that reducing the mortality of adult females is critical to maintaining the population. References to specific statements would allow a more specific response. Some statements may appear "tentative." This uncertainty is due to the intrinsic difficulty of predicting the future.

The final EIS describes the applicant's proposals to monitor the tailings, reduce traffic, discipline employees, and use bear-proof containers.

LETTER 20

The Forest Service is engaged in informal consultation with the Fish and Wildlife Service concerning this project, and is preparing a biological assessment under requirements of Section 7c. of the Endangered Species Act of 1973. The FEIS should include or reference this biological assessment. If formal consultation with the Fish and Wildlife Service is conducted, results of the formal consultation should be included in the FEIS.

LL Air Quality

The discussion on air quality on page II-58 should include the proximity of Class I areas such as Yellowstone National Park.

MM Economics/Employment

On page II-62, it will be necessary to revise employment figures for the Livingston area in anticipation of the scheduled closure of the Burlington Northern shops.

We suggest that the first sentence on page V-2 would be more accurate if it read "Denial of the permit would have an enormous effect on potential future growth of the project area economy." Denial of the permit would have no noticeable effect on the present economy, which would remain more or less the same.

NN Sociology

On page 10 of the "Summary" and under Social Values on page III-54, we believe the EIS is too hesitant about stating eventualities. The following statement is an example:

> The increased population; additional traffic, especially during construction; increased noise at the minesite from mine/hill construction and operation; impacts to the physical environment; and potential social conflict could cause people to perceive changes in the characteristics of the area they value most.

This language appears to be excessively qualified and over cautious. The changes listed in the first three lines of the statement are real. They are actual changes in the characteristics of the area by almost anyone's standard of measurement. People will undoubtedly perceive this.

On page III-58, recent fires in Gardiner and Livingston may change the status of schools in Park County.

OO Recreation

On page II-103, the Yellowstone Park Recreation Program is not the only formally organized recreational program in the area. The Interpretive Division of the National Park Service holds a wide variety of summer and winter activities in the Mammoth area, including nature walks on the Hot Springs Terraces, historical walks around Fort Yellowstone, evening programs at the Mammoth Campground and at the Mammoth Hotel, and activities associated with the Horace Albright Museum at Mammoth. The Forest Service may also sponsor an interpretive program. In addition, there are a number of sporting programs offered to students at the Gardiner school, which also serve as recreation for those watching.

The final EIS refers to the biological assessment and includes the Fish and Wildlife Service's biological opinion (see Chapter III--Threatened and Endangered Species).

LL Comment noted. See revised air quality discussion in Chapter III.

MM The employment and income projections for Park County have been revised to reflect the impact of the closure of the Burlington Northern shop. Please note revised statement in Chapter V.

NN The wording has been changed to state that people would notice such impacts. However, the point of the paragraph is that people may not perceive such impacts negatively. Your comment about schools is noted. Please see the revision in Chapter III--Sociology, Education.

OO Comment noted thank you. Please see revised text.

LETTER 20

On pages II 68-75 and III 71-72, we suggest adding a discussion on the impacts of the project on the visitors to Yellowstone National Park. This visitor population is significant, particularly in summer, and would be affected by the traffic, visual, and auditory impacts of the proposal. For example, of the total 2,262,969 recreation visits to the park in 1984, 331,404 people entered the park through the North Entrance at Gardiner. Of these, 303,030 (about 13 percent of the total) entered from May through October. During May through October 1985, 317,000 persons passed through this entrance for recreation visits. Source: Monthly Public Use Reports, park files.

PP Aesthetics

Concerning visibility of potential tailing sites (pages I-15 and II-110), we suggest the EIS stress visibility from the park more strongly as a major concern. We suggest inserting the following: "Mammoth Hot Springs is a major visitor use area in the summer, and many visitors' experience would be adversely affected by visible tailing site. The vista north and northeast from the Upper Terraces of the Mammoth Hot Springs is a popular one with visitors; the most heavily used parking area on the Upper Terrace Drive is also the foremost area for viewing this vista."

On pages III-73 and 74, we also suggest that EIS address the effect of lighting for night operations. Anything the applicant can do to reduce visibility of mine activity from Yellowstone National Park will be helpful. The suggested mitigating measures should be mandatory.

Sincerely,

Robert F. Stewart

Robert F. Stewart
Regional Environmental Officer

PP Only a portion of the tailings site would be visible from a few locations near Mammoth Terraces. Even then, the tailings would be far enough away from Mammoth to appear as only a small part of the panoramic views, and visible only through binoculars. DSL does not agree that visitors' experience would be "adversely affected" by the tailings site. In addition, the tailings site would be revegetated in increments during the operation, and fully revegetated after operation, so that any visual obscurement of the landscape would be temporary.

Thank you for your comment. However, lighting for night operations would not be visible from the park any more than is lighting currently used by the residences in Jardine.

LETTER 21

ONLY YEAR AROUND ENTRANCE TO YELLOWSTONE PARK

"TEDDY ROOSEVELT ARCH"

Gardiner Chamber of Commerce
P. O. Box 81
Gardiner, Montana 59030

RECEIVED
DEC 1 7 1985
STATE LANDS

Mr. Kit Walter
Chief, Environmental Analysis Bureau
Department of State Lands
Helena, MT. 59620

Dear Sir

The Gardiner Chamber of Commerce would like to comment on the Draft EIS prepared for the Jardine Joint Venture. We support economic development for this community, we think that this mine is an important way to do that. At the same time we believe that many valid points were made at the public hearing on December 3rd which need to be dealt with by the final EIS. We ask your office to consider those issues raised by the many concerned citizens of the Gardiner-Jardine area at that hearing.

Sincerely

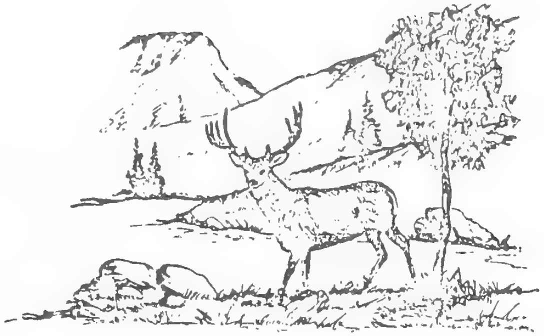
Richard Myers, President

*Drive The Valley Route through Majestic Mountain Scenery to The North Entrance of Yellowstone National Park — **FROM ANYWHERE***

Comment noted, thank you.

Gallatin
WILDLIFE
Association

Bozeman, Montana



LETTER 22

RECEIVED
DEC 17 1985
STATF LANDS

December 15, 1985

Montana Department of State Lands
1625 11th Avenue
Helena, Montana 59620

RE: Comments on Jardine Joint Venture Project Draft JDEIS

The Gallatin Wildlife Association (GWA) is pleased to have the opportunity to comment on the Jardine Joint Venture Project Draft JDEIS.

GWA is a Bozeman based sportsman's conservation group. Our membership consists of resident sportspersons that utilize the Gallatin National Forest area. GWA is a Montana and National Wildlife Federation affiliate.

Our primary concern with the JDEIS is its prospective cummulative impacts on the very prominant Yellowstone Ecosystem wildlife resource and the sportsmen's use of this wildlife resource. Our comments will focus on the mine's impacts on the Big-Game resource, the Blue-ribbon fishery of the Yellowstone, and the Threatened and Endangered Species.

It is our position that this joint venture will create impacts on the valuable wildlife resource and wildlife user groups. We further contend that it is the mine's responsibility to insure that rigorous mitigation of these impacts occur on behalf of the public and the wildlife resource. The financial responsibility to pay for these mitigations should be with the Jardine Joint Venture.

Specific Impacts:

A Elk and Mule Deer - The wildlife study area described in the draft JDEIS entails a portion of the Northern Yellowstone elk herd's winter range. This herd is the world's largest elk herd. The study area also encompasses the winter, fall and some summer range of a resident herd of 350 (+/-) animals. Mule deer occupy the entire study area.

The impacts of the mine project include a) disruption of migrating elk, b) poaching, c) carrion-road kill, d) animal poisoning, e) cummulative impacts (access issue, logging, domestic sheep, new roads), and f) more people in less secure wildlife habitats.

B Bighorn Sheep and Bison - The primary impacts include a) poaching of record or trophy males, b) stress on bighorns from other displaced ungulates, c) stress from increased human presence. Stress is not easy to measure and may

A The EIS discusses these issues. Please note that significant disruptions of elk migrations are not predicted. Identifying the magnitude of some impacts you have mentioned is not possible. Also, there are several unknown factors in the poisoning scenario (see response to letter 20, JJ). The final EIS discusses the applicant's proposal to monitor the tailings area and specifies a fence around the return-water pond.

B The EIS addresses the poaching issue. Mule deer and elk--the most common species--would be exposed to more poaching than would bighorn or bison.

LETTER 22

show up secondarily in sheep in form of epizootics (pink eye, pneumonia, etc).

C Threatened and Endangered Species - Grizzly Bear - the wildlife study area contains grizzly bears and critical habitat components necessary to the species survival. These critical components include a) winter-spring ungulate habitat, b) riparian and associated succulant zone, c) Whitebark pine and Whitebark/Subalpine Fir habit components.

The mine project will increase the risk of grizzly mortality and human-grizzly confrontation in the following ways: a) increased presence of humans in winter range, wet-sites and fall pine-nut habitat, b) increased carrion near human travel corridors, c) poaching, d) grizzly bear poisoning.

Bald Eagle - The area contains bald eagles, especially during winter and early spring. The eagle is attracted to the mine's impact area by carrion (elk and deer).

The primary impact is a) poaching for eagle parts and b) "Chicken hawk syndrome" or indiscriminate killing of large unidentifiable raptors by people ignorant of the raptors' role in the ecosystem, and ignorant of wildlife law.

Fisheries - The Yellowstone River is a primary blue-ribbon trout fishery. Bear Creek is trout-rich spawning and natural trout tributary (headwater) of the Yellowstone.

The Yellowstone is a primary tourist and resident recreational fishery. A long range fishing economy is dependant on this stream's health.

The mine venture is upstream from the Yellowstone River. Bear Creek flows through the mine's impact area.

D The primary impact of this mine on the Yellowstone's fishery could be in the form of pollution to this important fishery. This pollution could come in the form of heavy metal toxics flushed by flood from the mine's tailings. Or pollution could occur from groundwater - primarily in the form of cyanide leaching from the tailings or mine site.

E This pollution could severly impact Bear Creek and the Yellowstone River fisheries by destroying fish and aquatic invertebrate productivity. The cummulative impacts of this mine, and logging in Bear Creek's headwaters could be catastrophic. This could pose severe economic and recreational hardships for wildlife user groups.

Proposed Mitigation:

While it is not the place of a wildlife conservation group to advocate a venture as proposed at Jardine, we can encourage and support a rigorous mitigation plan that insures that the wildlife resource of the Yellowstone Ecosystem is not severely impacted during the life of the mine.

F Mitigation 1) We suggest that the company fund the hiring of two full time wildlife monitors. These monitors would be employed by the State of Montana Department of Fish, Wildlife and Parks. Their responsibilities would include the following:

a) monitor carrion distribution, especially adjacent to human use corridors. The monitors would identify critical wildlife crossing areas and remove

The possible effects of stress by humans are also covered in the draft. We do not feel that displaced ungulates would unduly increase stress on bighorn.

C All the impacts you mention are discussed in the EIS. However, the revised plan proposed by the applicant would combine with mitigating measures required by the permitting agencies to lessen impacts.

D The EIS does not predict that flooding of tailings would be a factor contributing to water quality degradation. The disposal facilities are relatively isolated from any major catchment area. The hillside directly above the facility has a total area of 0.7 square miles. For a precipitation even with a total of 3 inches precipitation over a six-hour period, the maximum flow in the diversion trench would be less than 65 cfs. This precipitation is in excess of the 100-year recurrence interval event. The size of a diversion trench required to safely conduct this flow rate would be approximately 4 feet wide and 2 feet deep for a slope of 0.5 percent.

The major diversion for the hillside catchment would be routed downstream of the seepage pond. The slope over most of the ditch would be maintained at 0.5 percent. The ditch would be revegetated to produce a grasslined channel. Suitable riprap would be placed in the reach of the diversion into the drainage below the seepage pond to stabilize the channel.

During each stage of the impoundment development, the upstream limit of the facilities would be protected from runoff by an additional diversion ditch.

LETTER 22

The tailings would be reclaimed as the material is deposited. Runoff from the reclaimed area would be routed in a lined channel at the apex of the reclaimed surface and the perimeter dike. Flow from the reclaimed area would be introduced to the main hillside diversion and discharged below the seepage pond.

Please refer to letter 14, response D. The EIS does not predict that ground or surface water contamination by cyanide would occur. In addition, please refer to letter 15, response D3.

E Please see response D for information on metals. Increases in sediment due to logging would not be great enough to significantly affect aquatic invertebrates in Bear Creek (see Chapter III--Aquatics). The final EIS notes that sediment increases would not affect Bear Creek fisheries. No impacts on aquatic life in the Yellowstone River are expected. Recreational and economic hardship, therefore, are not included in impact analyses.

F Most of the objectives of this mitigation would be accomplished without wildlife monitors (see Mitigating Measures). Specific comments on your suggestion follow:

a) Carrion would be monitored and removed by the cooperative efforts of government agencies.
b) Grizzly bear use of the threatened and endangered species assessment area has already been addressed. Studies by the Interagency Grizzly Bear Study Team would probably continue. Managing grizzly movement would be difficult or impossible.
c) Please see mitigating measures for hydrology. The lack of predicted impacts on aquatic life does not justify an aquatic monitoring program.
d) The applicant proposes several measures to manage people (for an example, see Chapter III--Wildlife). The permitting agencies would recommend additional mitigating measures. The Park County sheriff; the Department of Fish, Wildlife, and Parks; and U.S. Fish and Wildlife Service would continue to enforce fish and wildlife laws. The Department of State Lands would inspect the permit area regularly.
e) The Department of State Lands would require the applicant to eradicate noxious weeds from the permit area. Noxious weeds outside the permit area would be controlled pursuant to the County Noxious Weed Management Act (7-22-2101 et seq. MCA).

LETTER 22

carrion from road sites that might attract grizzlies and bald eagles;

b) The monitors would identify grizzly use areas near the mine site, road corridor and study area. Grizzly movements would be managed near human habitations and at toxic sites;

c) The monitors would sample water and aquatic invertebrate quality to check for changes in the stream environment.

d) The monitors would manage people, enforce mine and wildlife regulations and support ongoing enforcement activities in the mine study area.

e) The monitors would control noxious weeds where they occur along the mine thoroughfare. USDA-FS and County should contribute to this mitigation effort also.

G Mitigation 2) The mining company should purchase a major insurance bond to protect the stream system and Yellowstone from mine related catastrophe. There should also be a financial liability required in case the mine company should attempt to avoid full reclamation of the mine's impact.

H Mitigation 3) A water and invertebrate quality study should be funded to establish a baseline of data for before, during and after monitoring and comparisons of stream quality. If the stream quality deteriorates the mine should have a **shut-down clause** imposed until the stream pollution problem is solved.

I Mitigation 4) No new roads or logging should occur in Bear Creek during the life of this mine venture.

J Mitigation 5) Ash Mountain domestic sheep allotment must be disbanded. However, we do not support moving these sheep to pristine elk and bear habitat in the Boulder. That essentially moves a problem to a non-problem area.

K Mitigation 6) Elk-proof the tailings zone; disband the fence when the mine life ends.

L Mitigation 7) Manage traffic. Mine employees should be pooled on a daily basis by the company bus from Gardiner to Jardine to eliminate 150 single units, all shifts of the day, totally unmanaged traffic, which would create a wildlife and human hazard. We feel that current hunting season traffic patterns are severe as is. This mine creates a traffic problem, so it is the company's responsibility to solve the problem.

M Mitigation 8) The monitors should enforce company and wildlife mitigation regulations on mine employees. Breach of company wildlife regulations should be met with severe discipline - including loss of employment and fines.

N Mitigation 9) The company should be held accountable for major poisoning of wildlife species. Threatened and Endangered species related death, or stress, pollution (fish kills, etc), should be met with major fines and liability. Litigative handles should be designed by the State.

Conclusion:

It is the mine company's choice to locate in one of the world's most significant wildlife habitats. Wildlife and wildlife recreationists constitute the major use, in the long range view of this area. The mine should be held totally accountable for the impacts it creates on the critical and public wildlife resources. Agency budgets and personel are stressed as it is. Part of this company's investment must go toward doing a good job minimizing its

G The Montana Department of State Lands would collect bond from the applicant before construction, as specified in the Metal Mine Act. This bond, amounting to $1.2 million, would be released only after the applicant has successfully reclaimed the permit area and fully complied with the requirements of the Metal Mine Act.

H Baseline water quality and invertebrate data have already been collected. This information is summarized in the EIS. Also, please refer to letter 17, response C, regarding revoking or suspending permits.

I A logging prohibition in Bear Creek during the life of the project is not warranted at this time. The USDA Forest Service would apply the grizzly bear standards and guidelines and elk and timber management coordinating recommendations on a case-by-case basis to all future timber sales in Bear Creek. Activities in the Bear Creek drainage, including the JJV project, would be considered by the Forest Service within the framework of the guidelines recommendations before approval of timber-sale prescriptions.

J The Ash Mountain allotment is within grizzly bear habitat classified as Management Situation 1. The Boulder area lies within Management Situation 2 habitat. Gallatin National Forest's management goals include eliminating sheep allotments from Situation 1 habitat. The Forest Service, therefore, considers the relocation appropriate. The Grizzly Bear Standards and Guidelines for Gallatin National Forest (USDA Forest Service, 1984, p. 4) explains the Management Situations.

K The applicant proposes to fence the seepage collection pond. A fence around the return-water pond would be required. The remainder of the tailings area would be monitored for elk use and, if necessary, a fence would be constructed (see revised text). The applicant has committed to removing all surface support facilities at the end of mining. This commitment would include fences.

L The JJV has committed to an employee carpool and bussing program. Please see letter 16, response B.

M The applicant has committed to developing and enforcing a wildlife policy within the permit area. Some features of this policy are listed in Chapter III-Wildlife. In addition to the applicant's policy, federal and state laws would serve as deterrents to potential violators.

N If a link between these impacts and the applicant's operation were established, the applicant would be held accountable. Existing state and federal laws would allow for litigation.

LETTER 22

impacts on the Yellowstone Ecosystem's wildlife resource. Thank you for this opportunity to comment.

Sincerely,

Pat Simmons

Pat Simmons
President

CC Senator Max Baucus, Senator John Melcher, Representative Pat Williams, Representative Ron Marlenee, Montana Wildlife Federation, National Wildlife Federation Natural Resources Clinic, Gallatin National Forest, Department of Fish, Wildlife & Parks, Montana Fish & Game Commission, Yellowstone Coalition, Madison-Gallatin Alliance, Montana Wilderness Association

LETTER 23

United States
Environmental Protection
Agency

Region 8, Montana Office
Federal Building
301 S. Park, Drawer 10096
Helena, Montana 59626

EPA

REF: 8MO

December 16, 1985

RECEIVED
DEC 17 1985
STATE LANDS

Mr. Kit Walther
Chief, Environmental Analysis Bureau
Montana Department of State Lands
Capitol Station
Helena, Montana 59620

Dear Mr. Walther:

The United States Environmental Protection Agency (EPA) has completed our review of the draft environmental impact statement (DEIS) written by your agency and the U. S. Forest Service for the Jardine Joint Venture Project. Our overall concerns with this project are centered around potential air and water quality impacts. In addition the Agency has questions about the adequacy of proposed water quality monitoring.

EPA strongly supports those mitigating measures suggested by the Department of State Lands and the U. S. Forest Service listed in Chapter III of the DEIS. The Agency believes that the project should only be permitted if the mitigation measures are made part of the necessary State and Federal permits.

Our specific concerns are listed in the attachments. Overall, the DEIS is very well written, organized, and is informative.

According to EPA's system for rating draft environmental impact statements, this DEIS is rated EC (Environmental Concerns - Insufficient Information). EPA has no significant objections to the project as proposed if the mitigation measures listed in the DEIS are imposed, and our additional concerns are addressed.

If you have questions, please contact Mr. Dick Montgomery of my staff at 449-5486.

Sincerely,

John F. Wardell

John F. Wardell, Director
Montana Office

Attachment

cc: Montana Department of Health and Environmental Sciences

LETTER 23

ATTACHMENT

EPA Comments on Jardine Joint Venture DEIS

A Chapter II, page 13: The results for all of these parameters should be summarized somewhere in this report and should include analytical methods references.

B Chapter II, pages 14-15, Table II-6: Metals data should have reported totals, not simply dissolved, since total levels appear to be more relevant to the uses for which criteria have been set.

C Chapter II, page 17: How well has the hydraulic connection between the projects underlying bedrock and the alluvium been documented? Can the sources of contribution of As, and other metals in the ground water, be distinguished between the existing tailings and mine waters? This information is more important if the mines are used as a disposal location for future tailings - possibly further contaminating the bedrock aquifer.

D Chapter III, page 18: Can the buried wastes identified here be located and remedied, if appropriate? In addition, EPA requests that a complete data set for the ground water/surface water investigation be submitted to this office for review related to the Federal Comprehensive Environmental Response, Compensation and Liability Act (Superfund).

E The EPA Criteria Document for Cyanide was updated and revised in January 1985. The cyanide toxicity data shown in Appendix 7 (Chapter VII, page 15) does not include this data. The updated EPA criteria indicate that a four day average concentration of cyanide should not exceed 5.2 ug/l more than once every three years, and the one-hour concentration of cyanide should not exceed 22 ug/l more than once every three years to avoid acute toxicity to aquatic life. EPA will be happy to provide you with a copy of the Cyanide-Updated Criteria document.

F Old tailings will apparently be removed as a result of this mining venture. This removal in conjunction with a well designed and operated waste treatment and disposal system could actually improve Bear Creek water quality. A water quality monitoring program is briefly discussed in Chapter III, page 9. EPA believes, however, that biological monitoring should be included in such a program. The likelihood of a chemical monitoring program detecting a spill of a toxic contaminant is fairly remote. Monitoring of aquatic communities in Bear Creek, however, would provide an indication of whether or not toxics were entering the stream. Baseline biological communities information should be collected for Bear Creek, and periodic monitoring should be carried out after the mine is put into operation for comparison with the baseline data. This type of monitoring will provide the most reliable indication of the impact of the proposed mining operation on aquatic life. This monitoring information should be provided to the Water Quality Bureau of the Montana Department of Health and Environmental Sciences (MDHES).

A EPA Standard Methods for Water Quality Analyses

Parameter	Analysis Method	Parameter	Analysis Method
pH	150.1	Bicarbonate HCO_3	310.1
SC	120.1	Chloride CL	325.3
TSS	160.2	Sodium Na	273.1
TDS	160.1	Potassium K	258.1
Turb	180.1	Fluoride F	340.2
Total Alkalinity	310.1	Aluminum AL	202.1
Total Nitrate (NO_3 + NO_2)	353.2	Cadmium Cd	213.2
Orthophosphate	365.1	Chromium Cr	218.1
Total Ammonia (NH_3 + NH_4)	80.3	Lead Pb	239.2
Sulfate SO_4	375.3	Manganese Mn	243.1
Calcium CA	215.1	Mercury Hg	245.2
Magnesium Mg	242.1	Selenium Se	270.2
Hardness	by calculations	Vanadium V	286.1
Arsenic As	206.2	Zinc Zn	289.1
Copper Cu	220.1	Boron B	212.3
Iron Fe	236.1	Cyanide CN	335.2
Total Acidity	305.1	Oil & Grease	413.1
Carbonate	310.1		

B The statement by Region 8 EPA that "total levels appear to be more relevant" is inconsistent with information contained in a memorandum from John F. Kopp, Chief, Physical and Chemical Methods Branch, U.S. Environmental Protection Agency, dated April 1, 1980. This memo, reproduced as Appendix 18, in part, states:

> . . . biologists have pointed out on numerous occasions that EPA should be more concerned with recoverable metals than total metals because metals bound within the sediment particle probably would be non-reactive from a toxicity point of view.

This point of view is also supported by the Montana State Department of Health and Environmental Sciences, Water Quality Bureau. A memo from Abe Horpstead dated June 12, 1984 (reproduced in Appendix 18) in part states:

> The biological significance of these various forms or fractions of the metals present is a matter of some dispute. It is usually accepted that dissolved metals are biologically significant.

For these reasons, baseline concentrations of dissolved metals are presented in Table II-6. At the agency's request, a complete data set for both the ground and surface water investigations were sent to EPA, Region 8, Montana Office, for its review.

LETTER 23

C The hydraulic connection between bedrock and alluvium is not well documented. However, commitments by JJV, outlined in the response to letter 19, comment G, would significantly reduce the potential for contamination.

D Page III-18 of the draft EIS does not identify any buried wastes. Rather, it provides a rationale for varying the replacement soil depths. Note that the JJV proposes to incorporate the existing (exposed) tailings into the new, lined tailings dump. The tailings dump would be capped with clay, topsoiled, and revegetated. EPA is welcome to review the surface and ground water investigations prepared by the applicant; these reports are available in the offices of DSL and the Forest Service.

E Table II-6 and Appendix 7 have been revised to reflect the new EPA criteria.

F Comments noted. Page III-5 of the draft EIS states:

> Two historic tailings impoundments would be removed and placed within the proposed tailings dump. This action would result in a decrease in the loading of cyanide, arsenic, and other heavy metals to the ground water system and Bear Creek.

Improvement in water quality would not adversely affect aquatic communities. Biological monitoring, therefore, would not be required. Appendix 15 outlines the water quality monitoring that would be conducted pursuant to Montana's Water Quality and Metal Mine Reclamation acts. If monitoring results show a change in water quality, measures could be designed to monitor the biota or mitigate impacts. Baseline biological data for Bear Creek have been collected (see Chapter II--Aquatics and Fisheries).

LETTER 23

G Chapter III, page 7: Because of the amount of sewage to be percolated through the soil, the location of the drainfield within 100 feet of Bear Creek, and the presence of historically high arsenic concentrations in the soil from previous mining activities, it would be prudent to consider an alternative sewage disposal system. The main concern is that elevated levels of arsenic may leach from the drainfield and adversely impact aquatic life in Bear Creek. Even if there were no high arsenic background soil concentrations, 100 feet are insufficient distance when locating a drainfield near a high quality stream.

H Chapter III, page 43: The air quality discussion is minimal. The air quality review should address potential impacts of toxic constituents which may be present in tailings. It is mentioned in Chapter III, page 26 that blown tailings could impact vegetation in reclaimed areas. It is also mentioned in Chapter III, page 45 that 3 to 75 tons per year of tailings would be emitted by waste dump. What would be the impacts on other aquatic, terrestrial organisms? Is there a danger from fugitive cyanide from mill?

I Ambient TSP discussion addresses Montana Ambient Air Quality Standards (MAAQS); but not National Ambient Air Quality Standards (NAAQS). There are differences between these standards, therefore, both sets of standards should be addressed. The background and predicted TSP discussions do not fully describe the spatial and physical relationships between potential sources, and TSP meteorological monitoring sites.

G Please refer to the response to letter 6, comment D.

H Additional information and discussion on airborne trace-element levels, particularly arsenic, have been added to the text. Baseline monitoring information has been added in Chapter II and additional discussion on impacts in Chapter III.

The range of 3 to 75 tons per year of tailings refers to estimated wind erosion emissions from the tailings surface. Given the operational design of the tailings facility, the required control measures, and the stabilization of the existing tailings in the area, the actual emissions should be at the low end of the range and impacts related to blowing tailings should be minimal and less than those experienced in the past.

Toxic hydrogen cyanide (HCN) gas would be liberated if the process solution is allowed to become acidic. The process must be maintained in a basic condition for proper operation. If the process solution were allowed to become acidic, a significant hazard could develop for workers in the immediate area. Dilution with ambient air would minimize the hazard away from the mill.

I Comment noted. Because the Montana Ambient Air Quality Standards are more stringent than or equivalent to the National Ambient Air Quality Standards compliance with MAAQS indicates compliance with NAAQS as well.

A detailed description of the background and predicted TSP studies is available in the referenced air quality permit application filed with the Department of Health and Environmental Sciences.

LETTER 24

This letter is a typed reproduction of a handwritten,
signed letter that was received by the Department.
The letter was typed for ease of reading after publication.

December 13, 1985

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Reclamation Division
Montana Dept. of State Lands
1625 11th Avenue
Helena, MT 59620

Dear Mr. Walther:

The icy roads scared me out from attending the December 3 meeting held in Gardiner to discuss the Jardine Joint Venture so I would like to state my views now.

First of all, I think this project is the best thing that could happen to Park County and all its residents, especially at this time. Most of the fears and questions posed by the few who live there should never materialize.

Comment noted, thank you.

I am speaking from first-hand experience because I lived in Jardine in 1924-25 and 26 when my father worked in the stamp mill for Mr. Bacorn. I went to school at that time.

Then in 1937 I returned to Jardine to work in the assay office as helper and later as assayer. During this period, I saw the forty stamp operating with the noise they made. We got used to that and was lucky and happy to have a job.

The tailings were deposited in a tailings pond without harm to anyone then. The cyanide plant was operating and to my knowledge caused no one any harm. We even had a smoke stack putting out arsenic fumes that caused very little complaint.

The water from the mine, to my knowledge, never did reach to an area to cause any harm. In 1924 to 26, arsenic was hauled to Gardiner as was the calcines (concentrates that had the arsenic roasted out). Only once did an arsenic truck go over the bank on the "Z" hill. The road at that time was a one-vehicle-wide road.

As far as the elk and deer are concerned, when conditions are right they will migrate regardless of the traffic. When snow is 1 to 1-1/2 feet deep with a two-inch hard crust, a moonlight night at about 20° below zero, the elk will move regardless of the traffic or hunters. I know, I was there!

A road is still possible from the airport area if the route is changed some. This would eliminate the fear of traffic through Gardiner.

LETTER 24

Page Two

All in all. the fears expressed now by folks who never knew Gardiner and Jardine existed, could have been made in those early days. They were not made and the community prospered as it will in the future if the Joint Venture is given the go ahead. Thank you for listening to my views.

Yours truly,

George Ommundsen

c: Jardine Joint Venture

LETTER 25

This letter is a typed reproduction of a handwritten,
signed letter that was received by the Department.
The letter was typed for ease of reading after publication.

Jardine Route, Box 185
Gardiner, MT 59030
December 14, 1985

Mr. Kit Walther
Chief, Environmental Analysis Bureau
Montana Dept. of State Lands
Helena, MT 59620

Dear Sir:

I am writing in regard to the Joint Venture meeting I attended December 3 in Gardiner. With great interest, I sat and listened to the people as they voiced their concerns. We are all concerned about the toxic wastes and well we should be. We read the papers and watch the news on TV and are aware of what is going on around us. A few years ago one of the buildings was cleaned out and the waste was stockpiled on the edge of Bear Creek on our side of town. The men had a small trailer they were staying in and while working were dressed in complete white uniforms plus face masks. This substance was loaded into trucks labeled Poison B on the outside. As the men went into the trailer they would drop those uniforms on the ground, then they were loaded on the trucks also. Two of those large trucks traveled together. We thought to Idaho. What shook us up and the odor from the stockpile was bad. I had a horse that would go to this area and roll in the dust every chance he'd get out of my place. He became listless and suffered spots of hair loss on his back. We doctored him several months, but he never got well enough to use. As soon as the building was cleaned, the rats were disturbed and started moving. We spent several days and nights trapping and shooting them in our barn. We should have sent a couple to a lab to see if there was a contamination on them.

If Bear Creek has a spill of waste due to earthquake, man-made accident, excessive rainfall, the flow would go down the Yellowstone River for several miles. I could show you how the spring then completely washed my road going down into Palmer Creek. I question this "Good Neighbor Policy" that was brought up at the meeting. I think it depends on who the neighbor is. With the economy being so bad in Park County, our commissioners only think of the $500,000 gift and nothing of the future consequences. Mr. Carlo Ceirci was very sure of himself when he mentions "grizzly bears do not come in to pay taxes." Maybe not, but a lot of us pay our taxes from money earned from hunting wildlife, such as elk, deer, moose, sheep. We outfitters get very little recognition on how we help the economy. Mr. Ceirci mentioned all the hunters' cars jamming the Jardine Road. All those hunters buy gas, food, clothing, lodging, drinks, etc. Maybe only lasts a few months, but does help the economy. Not to mention the tourists that use the road throughout the year.

When Mr. Blankenship sold to Anaconda their manager was named Hunter Ware. He and I and several people from the community that use this road met in Livingston with the County Commissioners. They promised us everything that

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was mentioned in the meeting last Tuesday. That included guardrails on all the dangerous parts of the road including the top of Z Hill. I rolled down that mountain September 15, 1973 and broke my back. Had the guardrails been put in that wouldn't have happened. Consequently, I will suffer pains the remainder of my life.

A I own 55 acres of land where I now live. When we acquired the land, the U.S. Government retained the mineral rights. I inquired around about filing for mineral rights on my place to protect my property. I was told there was no need for that and was told the mineral rights belonged to the U.S. Government and couldn't be touched. Now, I understand the Joint Venture own the mineral rights under my place. I'm not too sure of the surface rights.

B At the meeting one outfitter said he'd be run out of business on account of the mines. That's not my worry. The GY man names Anderson said we need a place for the animals to go, but we also need a place for the elk to go through to get to that place. The land between Palmer Creek and the rims on Deckkard and the Bear Creek crossing are very critical and that is the reason Kathryn Johnson is trading her land to make sure the elk have a migration route. I was going to stay and listen to you explain to Mr. George Athias the land exchange, but he has had it explained to him at each meeting I've attended. My main worry is: Will the Joint Venture stake out my 55 acres or have they already done so and what assurance will Kathryn Johnson have that the land will be open range for the animals.

There is a piece of land approximately 4 acres more or less between the N. Fork of Bear and Bear Creek and one side the Joe Dandy that is an old Indian camp. I've mentioned it to the Forest Service, but they weren't interested.

I read in the Billings Gazette that Clarence Johnson was the only one opposing the mines. That is not so, regardless of what Larry Lewis said, Clarence was the only one with "guts" enough to speak up.

C Last December Mr. Olin Hart and Jerry Danni came to my home to inform me that extensive work had been done to deaden the noise and the level would be minimal. I took them to the front of my house and the noise was worse than it had ever been. They just looked at each other and walked back to their vehicle. The noise from their new crusher (I can see from my house) is loud. I have enjoyed the peace and quiet from 30 years and realize progress has top priority in this day and age.

I can remember when Chet Huntley came back to his home state to give it a boost in economy. He fought and won to build the Big Sky in the Gallatin. After raping and destroying a beautiful piece of land, they are still struggling to make a go of it.

D Have you been reading of the arsenic levels in the children at Anaconda? I can't believe the water boards were so generous with the mining company. I'm having a time keeping enough water to irrigate 5 acres on Deckkard.

Thank you for your time.

Sincerely,

Kathryn M. Johnson

A According to records on file with the Gardiner Ranger District, the land patent conveyed to Vernon Johnson on September 10, 1974, appropriated the title to the surface, but not to the minerals. Although the JJV (Homestake Mining Company) has filed an unpatented claim on the underlying minerals, the claim is not valid because the federal government withdrew the tract from mineral entry. As a condition of the land exchange between the JJV, the Forest Service, and you, the JJV would have to relinquish its unpatented claims on the 55 acres of Forest Service land surrounding your property.

B The land exchange and the mine permitting process are not related. The Jardine Joint Venture has already claimed the mineral rights to the 55 acres (L. Lewis, District Ranger, U.S. Forest Service, pers. comm., January 31, 1986). Assurances regarding the management of surface acreage would depend on your negotiations with the Jardine Joint Venture.

C Please see letter 32, response N.

D Please refer to letter 24, comment F. By removing an existing source of arsenic contamination, the proposed project has the potential to improve existing conditions.

Many of the responsibilities of the now-defunct State Water Board have been transferred to the Montana Department of Natural Resources and Conservation (DNRC). After adoption of the State Water Use Act, all Montana water users were required to file water rights claims with DNRC.

Water rights claims do not give the applicant a bona fide right to divert water. To obtain a bona fide water right, the individual water rights claims must be adjudicated under the current statewide adjudication process. Adjudicating water rights claims is the sole responsibility of the Montana Water Court. At this point, JJV has filed water rights claims for 201.6 cfs of water from Bear Creek. These claims have not yet been adjudicated by the Water Court, and are therefore not considered to be a bona fide right to divert this quantity of water. The issue of whether or not JJV's water rights claims would be considered abandoned would be settled through the adjudication process.

LETTER 26

Greater Yellowstone Coalition

December 16, 1985

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Sherm Sollid
Geologist
Gallatin National Forest
U.S. Forest Service
P.O. Box 130
Bozeman, MT 59771

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Reclamation Division
Montana Dept. of State Lands
1625 11th Ave.
Helena, MT 59620

Dear Sherm and Kit:

The Greater Yellowstone Coalition appreciates the opportunity to comment on the proposed mining project of the Jardine Joint Venture. The Coalition is an alliance of 45 regional and national conservation groups. We hope to preserve and protect the Greater Yellowstone ecosystem over the long term by establishing a method of decision-making that: 1) considers the effects of plans and decisions on the Greater Yellowstone ecosystem and 2) considers the cumulative effects of many proposed and ongoing actions.

Among our member organizations are the Bear Creek Council, the Fishing and Floating Outfitters Association of Montana, the Great Bear Foundation, and the Gallatin Wildlife Association, all of which have expressed serious concerns about this project.

We have studied the Draft Environmental Impact Statement and observed the performance of the company in the exploration and environmental analysis phases of the project. The agencies appear to have made a good faith effort to protect this sensitive area within the limits of the law and the regulations. The company appears to have made a good faith effort to be a good environmental citizen, for example by cleaning up hazardous wastes left by its predecessor. We would prefer that there not be a mine in Bear Creek. However, given the mess left by past mining, we see the potential for the project to improve the environment of Bear Creek.

It is often said (most often by miners) that minerals are where you find them. True enough. But the Greater Yellowstone ecosystem is also where you find it. This ecosystem is said to be the largest, essentially intact ecosystem in the world's temperate zones. With Yellowstone National Park at its core, it is internationally significant for its geothermal, geological, and wildlife resources.

It is the good fortune of the Jardine Joint Venture to have found gold. But it is the misfortune of the Jardine Joint Venture to have found gold:

40 East Main Street • P.O. Box 1874 • Bozeman, Montana 59771 • (406) 586-1593

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in the Greater Yellowstone ecosystem,
within sight of Yellowstone National Park,
in Situation 1 grizzly bear habitat,
next to a cutthroat trout spawning stream, and
adjacent to elk winter range and a migration route.

The Greater Yellowstone Coalition is extremely concerned about the effects the mine would have on the Park, on grizzly bear, on trout, and on elk.

Cumulative Effects Analysis

The Greater Yellowstone Coalition urges the agencies to assess the cumulative effects of several ongoing and proposed resource development activities, among them gold mining, oil drilling, logging, geothermal development, residential development in sensitive areas as a result of increased population pressures, increased use of the Absaroka-Beartooth Wilderness, and Ski Yellowstone. Review of the Draft EIS shows the agencies have made an attempt to do so. At least the cumulative effects of logging in Bear Creek and the Jardine mine have been discussed.

A However, the cumulative effects approach could be better. The method (which appears to be a seat-of-the-pants, back-of-the-envelop approach) has not been explained. The analysis is too limited--it should consider a wider range of activities, for example Ski Yellowstone, since the same grizzlies may use both areas, and sheep grazing on Ash Mountain. The Draft EIS is vague about proposed timber sales in Bear Creek. Are they planned or not? If so, when?

Monitoring

The sensitivity of the Jardine area to grizzlies, to trout, and to elk has been well established. If the project is permitted and constructed, it seems that it will be well-designed to minimize the adverse impacts.

B But the best laid plans almost always go awry. Because of the sensitivity of the area, the permit should assume that something will indeed go wrong, for example that grizzly mortality will be high, that the tailings pond will fail, that reclamation fails, that water quality standards will be violated, or that erosion and sedimentation will be higher that expected.

The permit should embody a direct feedback mechanism. If monitoring of the operation of the mine shows that design standards are not being met, then operation should be altered, curtailed, or stopped until the problem is solved.

A We are open to specific suggestions that would improve the cumulative impacts analysis. However, we feel that the best available methods of cumulative impact analysis were used in the EIS. Local biologists were contacted to estimate the area that could be visited by elk or deer that may also use the mine area (see figures II-11 and II-13). This area was then used to analyze cumulative impacts. For grizzly bears, the Hellroaring/Bear (Creek) Bear Management Unit (see figure II-16) was searched for proposed projects. The management unit was developed by the Interagency Grizzly Bear Study Team and is based primarily on repeated locations of radioed grizzlies. The management unit therefore generally encompasses the area that is used by the grizzlies that may be affected by mining.

Many sources were examined to find written proposals for development in the bear management unit. One such source was Threats to Greater Yellowstone (Greater Yellowstone Coalition, 1984). The southwestern portion of the management unit (corresponding to management subunit) was the only area containing any development proposals. These developments were limited to proposed timber sales. The Gardiner Ranger District supplied all available information on the sales (pers. comm., September 1985). Because the Ski Yellowstone lies outside of the bear management unit, it was not included in the cumulative impact assessment. Sheep grazing on Ash Mountain is an existing (baseline) condition, and was, therefore, excluded from impact analyses. Please see letter 2, response B and letter 22, response J.

B The JJV would monitor wildlife, air, water, and reclamation practices during mining and for a period of time after mining until the agencies release bond. Over the course of operations, the agencies would evaluate the JJV's monitoring reports to determine if the operation is adversely affecting the environment. Corrective measures would be implemented whenever monitoring identifies a problem.

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Page three
December 16, 1985

C **Compensation**

No matter how well designed and operated this project is, it will have adverse effects on the grizzly, the elk, and the trout.

This is especially important for the grizzly which is officially threatened in the Greater Yellowstone ecosystem and whose population shows a downward trend. The Jardine area has traditionally been a source of high grizzly mortality.

We propose a compensation approach to the mitigation of these unavoidable impacts. In the case of the elk, the unavoidable adverse impact of the mine could be offset by the acquisition of winter range in the nearby Yellowstone Valley. In the case of the cutthroat trout, spawning habitat in another nearby stream could be restored.

In the case of the grizzly, habitat could be protected or mortality could be reduced in another part of the bears' range. Specifically, funds could be provided to match the State of Montana grant to Gallatin County for the bear-proofing of dumpsters at West Yellowstone. That project will reduce the opportunities for bears to habituate to artificial food and, as a result, reduce the likelihood of human-bear conflicts. These conflicts almost always result, sooner of later, in the death of the bear. We request that the Jardine Joint Venture provide these matching funds.

D **Summary**

The final Environmental Impact Statement should contain the results of a better cumulative impacts analysis. If the permit is granted it should include a feedback mechanism requiring the curtailment or cessation of operations pending the correction of problems. The Jardine Joint Venture should compensate for the unavoidable adverse effects on grizzlies, trout, and elk.

Sincerely,

Bob Anderson

Bob Anderson
Executive Director

C The impacts to elk and grizzly bear are analyzed in the EIS. There is no evidence to support the contention that mining would adversely affect trout. We feel that mitigating measures listed in the final EIS, along with the applicant's proposal, are sufficient for elk. The impacts to elk are not significant enough to justify distant land acquisitions. Changes in water quality, if any, that could affect trout would be detected by monitoring. The permitting agencies would require three mitigations designed to reduce impacts on grizzly bears. We agree that bearproofing dumpsters in West Yellowstone would help to reduce ecosystem-wide impacts created by all developments. The Greater Yellowstone Coalition and Gallatin County should contact the applicant to request a contribution.

D Please see, response A. The permitting agencies are authorized to take appropriate action if the applicant violates the mining permit. Other government agencies would also take action if they detect violations of environmental protection laws. The applicant has proposed measures to compensate for wildlife impacts (see revised text). Further compensation would be required in the form of mitigating measures listed in Chapter I.

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LETTER 27

Box 100, Jardine Route
Gardiner, Montana 59030
December 16, 1985

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Capital Station
Helena, Montana 59620

RE: EIS Jardine Joint Venture

Dear Mr. Walther,

I would like to express my opinion regarding the proposed rerouting of the Jardine road and Bear Creek bridge in the Jardine area. I am firmly in favor of Alternative #1 as shown on the map on page 1-9 and oppose strongly the original route proposed by the mine company.

The high quality of life available in rural Montana communities has vanished from much of the United States and will never again be resurrected. However, it continues to exist today in areas such as Jardine and great effort must be expanded to preserve it. Yet the economic facts of life are such that in order to continue to live in rural America, the local economy must stay healthy. Thus, big industry, and our small towns must, in some cases, work out the terms of co-existence.

Jardine is a community. Physically, it is constructed around a small "village green" (in front of the mine office). It contains historic buildings. Sending the road through the heart of this community as in the original proposal, would destroy the physical layout of this town. And, the physical layout of a town is an integral part of a town's personality. It would destroy its attractiveness as well.

Alternative # 1 would allow the community of Jardine to remain intact yet would still provide for the needs of the mining company. It would help the values and beauty of a small rural community to co-exist with industry in the area.

Thank you.

Yours truly,

Peggy Reich

Comment noted, thank you.

LETTER 28

MONTANA WILDERNESS ASSOCIATION

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DEC 17 1985
STATE LANDS

December 15, 1985

TO: Montana Department of State Lands

FROM: Montana Wilderness Association and Madison-Gallatin Alliance
Elaine Snyder, President MWA and Tom Heintz, President MGA

RE: Jardine Joint Venture Project DEIS

The Montana Wilderness Association and the Madison Gallatin Alliance (MWA/MGA) are pleased to have the opportunity to comment on the Jardine Joint Venture Project Draft EIS (JDEIS).

MWA has worked hard since 1957 to protect Montana's wildland heritage. The Montana Wilderness Association is a volunteer, non-profit, conservation organization, primarily concerned with public lands. MWA was instrumental in securing protection of the Absaroka-Beartooth Wilderness, and worked closely with the Madison-Gallatin Alliance to protect portions of the Madison Range with the Lee Metcalf Wilderness Act. MWA is headquartered in Helena, and MGA in Bozeman, Montana.

Our primary concerns with the JDEIS are due to its prospective cumulative impacts on the very prominent Yellowstone Ecosystem. Our comments will focus on the impacts of the mine on the big game resource, the blue-ribbon fishery of the Yellowstone River and threatened and endangered species.

It is our position that this joint venture will create impacts on valuable wildlife resources, and further degrade the Greater Yellowstone Ecosystem as a whole. We further contend that it is the responsibility of the mine to insure that rigorous mitigation of these impacts occurs on behalf of the public and the wildlife resource. The financial responsibility for these mitigations should be with the Jardine Joint Venture.

P.O. Box 635 • Helena, Montana 59624 • (406) 443-7350

Your comments are identical to those that appear in letter 22. Please refer to letter 22 for our responses.

LETTER 28

Specific Impacts

Elk and Mule Deer. The wildlife study area described in the draft EIS entails a portion of the Northern Yellowstone elk herd winter range. The Northern Yellowstone elk herd is the world´s largest. The study area also encompasses winter, fall and some summer range of a resident herd of (+/-) 350 animals. Mule deer occupy the entire study area.

Possible impacts of the mine project include a) disruption of migrating elk, b) poaching, c) carrion-road kill, d) animal poisoning, e) cumulative impacts (access issue, logging, domestic sheep, new roads), f) more people in less secure wildlife habitats.

Bighorn Sheep and Bison. The primary impacts include a) poaching of record or trophy males, b) stress on bighorns from other displaced ungulates, c) stress from increased human presence. Stress is not easy to measure and may be seen secondarily in sheep in the form of epizootics (pink eye, pneumonia, etc.).

Threatened and Endangered Species. The wildlife study area contains grizzly bears and critical habitat components necessary to the survival of the species. These critical components include a) winter-spring ungulate habitat, b) riparian and associated succulent zones, c) white bark pine and white bark/subapline fir habit components.

The mine project will increase the risk of grizzly mortality and human-grizzly confrontation in the following ways: a) increased presence of humans in winter range, wet sites and fall pine-nut habitat, b) increased carrion near human travel corridors, c) poaching, d) grizzly bear poisoning.

The area contains bald eagles, especially during Winter and early Spring. The eagle is attracted to a mine´s impact area by carrion (elk and deer). The primary impact is a) poaching for eagle parts and b) "Chicken Hawk syndrome", or indiscriminate killing of large unidentifiable raptors by people ignorant of the role of raptors in the ecosystem, and ignorant of wildlife laws.

Fisheries. The Yellowstone River is a primary blue-ribbon trout fishery. Bear Creek is a trout-rich, spawning and natural trout tributary (headwater) of the Yellowstone.

The Yellowstone is a primary tourist and resident recreational fishery. A long-range fishing economy is dependent on the health of this stream. The mine venture is upstream from the Yellowstone River, and Bear Creek flows through the mine´s impact area.

LETTER 28

The primary impact of this mine on the Yellowstone´s fishery could be in the form of pollution to this important fishery. This pollution could come in the form of heavy metal toxics flushed by flood from the mine´s tailings. Pollution could also occur from groundwater - primarily in the form of cyanide leaching from the tailings or mine site.

This pollution could severely impact Bear Creek and the Yellowstone River fisheries, by destroying fish and aquatic invertebrate productivity. The cumulative impacts of this mine, and logging in Bear Creek headwaters could be catastrophic. This could pose severe economic and recreational hardships for wildlife user groups.

Proposed Mitigation

It is not the place of a conservation group such as MWA/MGA to advocate a venture such as is proposed at Jardine. We propose, encourage and support a rigorous mitigation plan that insures that the wildlife resource of the Yellowstone Ecosystem is not severely impacted during the life of the mine. It is our position that when mitigation is considered, the decision has already been made to give development a higher priority than to the natural resource. When mitigation occurs, wildlife is always the loser in the process.

Mitigation 1. We suggest that the company fund the hiring of two full-time wildlife monitors. These monitors would be employed by the state Department of Fish, Wildlife and Parks. Their responsibilities would include the following: a) monitor carrion distribution, especially adjacent to human use corridors. Monitors can identify critical wildlife crossing areas and remove carrion from road sites that might attract grizzly bears and bald eagles, b) identify grizzly bear use areas near the mine site, road corridor and study area. Grizzly movements will be managed near human habitations and at toxic sites, c) sample water and aquatic invertebrate quality to identify changes in the stream environment, d) manage people, enforce mine area wildlife regulations and support on-going enforcement activities in the mine study area, e) control noxious weeds where they occur along the mine thoroughfare. The USDA Forest Service and county should contribute to this mitigation effort.

Mitigation 2. The mining company should have a major insurance bond available to protect the stream systems and the Yellowstone River from mine-related activities. The State of Montana should not be left with a major environmental problem if the mine company attempts to avoid full reclamation of its venture´s impact.

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Mitigation 3. A water and invertebrate quality study should be funded to establish a baseline of data for before and after comparisons of stream quality. If the stream quality deteriorates, the mine should be required to shut down, through the imposition of a "shut-down clause" in its permit, until the stream pollution problem is solved.

Mitigation 4. No new roads or logging should occur in Bear Creek during the life of this mine venture.

Mitigation 5. The Ash Mountain domestic sheep allotment must be disbanded. However, we do not support moving these sheep to pristine elk and bear habitat in the Boulder area. That essentially would move the problem to a non-problem area.

Mitigation 6. Elk proof the tailings zone. The fence should be dismantled at the end of the mine life.

Mitigation 7. Manage traffic. Mine employees should be pooled on a daily basis by company bus from Gardiner to Jardine. 150 single units, during all shifts of the day and that are totally unmanaged will create a wildlife and human hazard. We feel that hunting season traffic patterns are severe at present. This mine wil create a traffic problem, so it is the responsibility of the company to solve that problem.

Mitigation 8. The company monitors should enforce company wildlife mitigation regulations for mine employees. Breach of company wildlife regulations should be met with severe discipline - including loss of employment and fines.

Mitigation 9. The company should be held accountable for major poisoning of wildlife species. Death of threatened and endangered species, or stream pollution (fish kills, etc.) should be met with major fines and liabilities. Litigative measures should be designed by the State of Montana.

Conclusion

It is the choice of the mining company to locate in one of the world's most significant wildlife habitats. Wildlife and wildland recreationists constitute the major use, in the long-range context of this area. Agency budgets and personnel are currently stressed. The mine venture should be held totally accountable for its impacts to critical and public wildlife resources. We feel strongly that a part of this company's mine investment must be to minimize its impacts on the Yellowstone Ecosystem.

cc: Montana Congressional Delegation

LETTER 29

This letter is a typed reproduction of a handwritten,
signed letter that was received by the Department.
The letter was typed for ease of reading after publication.

Jardine, Montana
December 12, 1985

Dear Sirs:

A In regard to the Jardine Joint Venture DEIS meeting held in Gardiner on
December 3, 1985, I brought up my concern over the placement of the tailings
pond in a critical elk migration area and a very sensitive geological are to
the gravel banks of Bear Creek. My property joins this proposed area on the
northwest side across Bear Creek where I have lived for the past thirty years
and raised a family of four children. I am a Montana big game outfitter and
have been in that business for the past thirty years in this location of and
above Jardine. My concern is the location of these tailings ponds and what
effect this is going to have on this health and my family and needless to say
what effect it will have on the migration of the elk which will have a direct
effect on my hunting business. I am not against the mining as long as there
is some truth put into the permitting to control what is being done. I know
the Joint Venture has a big interest in mining the gold and making a profit
and their leaving the area when the gold is mined out. I also have an
interest of living here the rest of my life with my family in a healthful
atmosphere and carrying on my family hunting business and making a profit. I
feel like us people in Jardine are going to be the sacrificial lamb to the
Joint Venture and the public that feels like they are going to profit from
this mining operation. Now the EIS book of the Joint Venture which is about
one inch thick and full of a lot of figures on no impacts on air, sound,
mining, tailings ponds, water, soils, roads, wildlife, historical buildings
and very few figures on people that live in Jardine. This book might impress
someone that likes figures but has no straight answers to questions that were
asked at the November 14 meeting in 1984 and the December 3 meeting of 1985
in Gardiner, Montana. I want to point out I have lived here all the time that
some of this fieldwork of Westech and others involved in this DEIS information
gathering was going on and I have to question some of their figures and
methods. I don't claim to know all the answers and I am sure nobody else
knows all the answers to the outcome of what impact the mining will have on
B the area. I do feel that the tailings ponds are being planned for a critical
area which could affect a very large area in case of a major earthquake or
extreme flooding or just natural erosion of the gravel bank above Bear Creek.
I have watched this erosion eat back into the bank of Bear Creek about thirty
feet since I have lived here. The mining company's claim that the tailings
ponds will cover about 9 acres which brings up my next concern. There is a
land exchange in progress between the Forest Service and the mining company
and Mrs. Katherine Johnson. My concern is the mining company's want to
exchange 200+ acres of patented mining claims for one parcel of land of 107
acres that will join the planned tailings ponds on the gravel bank above Bear
C Creek and extending down clear to the mouth of Palmer Creek on Decker Flat
which is a very important migration route for elk. The Forest Service claims
D that this exchange has no bearing on the mining venture which I have to
question. There has been no DEIS filed to my knowledge and the whole exchange
has been kept under tight wraps to the public. There has been three or four

A The health, safety, and welfare of the general public is a concern of the JJV, as well as both state and federal agencies. For example, remedial measures have already been undertaken to clean up arsenic wastes associated with the historic mill site. In addition, the existing tailings associated with historic mining activities would be physically removed and relocated to a double-lined tailings pile which would be capped and reclaimed with native vegetation. This action would decrease the potential for health hazards associated with blowing tailings.

Any changes in elk migration would not be large enough to affect your outfitting business.

DSL contends that the issues raised at the November 14, 1984, meeting in Gardiner, Montana, have been thoroughly addressed in the EIS. Furthermore, in response to the EIS process which included meetings, oral and written testimony, and numerous letters, the JJV has amended the original mine plan to address public concerns and to mitigate potential impacts. Please refer to the Preface of the final EIS.

B Extreme flooding of Bear Creek would not influence the tailings disposal site; the creek is over 100 feet below the site. Extreme runoff events could cause gully erosion of the runoff diversion ditch located along the southwestern edge of the dump (see figure III-2); however, the added sediment would not be significant and would be masked by the heavy sediment load contributed above the mine. Although small slump failures of the terrace adjacent to Bear Creek are inevitable, the terrace as a whole is quite stable.

Differential settlement within the terrace is the most that could be expected to affect the tailings dump over the foreseeable future. Even this settlement might not lead to environmental concerns; if the dump were reclaimed, the tailings would be essentially dry and therefore would not create a significant leakage problem even if the liner were to rupture due to differential settlement.

C Significant disruptions of elk migrations are not expected. Please see Chapter III--Wildlife.

D The land exchange and the mine permitting process are not related; the JJV's proposed project would not be affected by the outcome of the land exchange.

LETTER 29

legal notices printed in the Livingston newspaper which people hardly look at or read. I feel that this exchange does effect this mining project and if there is going to be 107 acres added onto the existing acres of the study area this charges the whole picture of the DEIS of the Jardine Joint Venture and should call for more public meetings to inform the public. I have repeatedly asked the Forest Service for more information on this trade and to get more information to where and what land is involved and they do not want he information out. As far as I know, the exchange will joint my property lines on two sides which I should have some input to the exchange.

Thank you.
George H. Athias
Jardine Route, Box 95
Gardiner, MT 59030

between the Forest Service, the JJV, and Mrs. Katherine Johnson. Regardless of the outcome, the JJV would not change the location or operation of the proposed tailings disposal dump or any other facilities associated with the proposed mine. Environmental impacts of the proposed project would, thus, be similar with or without the land exchange. The Forest Service would complete an environmental analysis (EA) before the land exchange could occur. The Forest Service would use the JJV EIS as a primary-source document for the EA. In addition, potentially affected parties would have an opportunity to comment on the Forest Service's EA. If the land exchange takes place, the Forest Service would acquire lands on Deckard Flats and Palmer Mountain. These tracts would be managed for wildlife.

LETTER 30

MONTANA
MINING
Association

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RECEIVED
DEC 17 1985
STATE LANDS

December 16, 1985

Dennis Hemmer, Commissioner
Department of State Lands
1625 Eleventh Avenue
Helena, Montana 59620

Dear Dennis:

The Montana Mining Association supports the "Jardine Project" proposed by the American Copper and Nickel and Homestake Mining Companies.

In keeping with modern mining in Montana, this project will be accomplished with environmental concern and social sensitivity. It has been proven that modern mining can occur with minimal disturbance in environmentally sensitive areas.

The Montana Mining Association also believes the project can proceed without moving the county road. Improvements to the road agreed to by the local governments and the companies should be supported.

Thank you for your consideration to this matter.

Sincerely,

Gary A Langley

Gary A. Langley
Executive Director

GAL/ld
cc: file

Comment noted, thank you.

DEPARTMENT OF HIGHWAYS

TED SCHWINDEN GOVERNOR
STATE OF MONTANA
2701 PROSPECT
HELENA MONTANA 59620

LETTER 31

December 17, 1985

RE: Jardine Joint Venture
Mining Project

Mr. Kit Walther, Chief
Environmental Analysis Bureau
Reclamation Division
Montana Department of State Lands
1625 - 11th Avenue
Helena, MT 59620

RECEIVED
DEC 19 1985
STATE LANDS

Dear Kit:

Thank you for the opportunity to review the above referenced draft EIS.

The proposed influx of traffic on U.S. 89 between Livingston and Gardiner, due to the referenced project, will not be significant enough to alter the level of service currently provided by this route.

Comment noted, thank you.

The majority of the impacts will be confined to the Gardiner-Jardine area and roads under County jurisdiction, therefore, we have no additional comments.

In March of 1985, we are scheduled to let two seal and cover projects to contract on U.S. 89. One contract will be from Gardiner-North for 5.6 miles and the other contract is south of Livingston for 11.8 miles. If the applicant is successful in beginning the mining project in the spring the 1986, contractors or personnel associated with this project may experience minor disruptions when traveling between Livingston and Gardiner.

Sincerely,

Don Cromer

Don Cromer, Supervisor
Rural Planning Section

DC:sk:2ff

cc: Buck Harris
Steve Kologi
Bill Dunbar, FHWA
Don Fallang

LETTER 32

NORTHERN PLAINS RESOURCE COUNCIL

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RECEIVED
DEC 17 1985
STATE LANDS

Dennis Hemmer
Commissioner
Montana Department
of State Lands
Capital Station
Helena, Montana 59620

December 14, 1985

Re: Comments on the proposed Jardine Joint Venture application and Draft Environmental Impact Statement

Dear Commissioner Hemmer,

Attached are the written comments and questions of the Bear Creek Council and the Northern Plains Resource Council. We will first make a few general statements followed by specific comments on the Draft Environmental Impact Statement (DEIS), and the Montana Department of State Lands,(DSL) and the U.S. Forest Service(USFS) proposed mitigation measures.

A We would like to make perfectly clear our objection to the agencies publishing a DEIS and holding a public hearing on what all parties admit is a "conceptual permit application". Why wasn't a plan for the mine and all associated facilities submitted with this application? We submit, that if the partners in the Jardine Joint Venture(JJV), Homestake Mining Company & American Copper and Nickel, truly want to be "good neighbors", they should be willing to include all important issues in the permit application and DEIS process. The point is, that several of the most significant areas of environmental concern and controversy have not been addressed in the application or DEIS. These include, but are not limited to: A detailed analysis and comparison of road alternatives, the information that would be included in an application for a water discharge permit, the mill and processing facilities final design , ie. will it built to withstand a major seismic event? Or, what are the full range and possible impacts of all potential toxic or hazardous materials to be used throughout the operation?

B Finally, why wasn't the corridor(s) discussed in the application and DEIS? We were aware, based on oral communications with Montana Power Company, for over a year, that existing facilities were inadequate to service the mine site. Why didn't JJV initiate discussion with MPC in time to have alternatives discussed in the application and DEIS? Does the DSL and USFS have the authority

A The JJV application is not a "conceptual permit application." The application meets the informational requirements of the Metal Mine Reclamation Act, Section 82-9-335, MCA and the Metal Mine Reclamation Act rules, 26.4.107 and 26.4.106 ARM. On December 27, 1985, DSL declared the JJV application complete, indicating that all necessary items had been included in the application. "Significant areas of environmental concern and controversy" are normally not addressed in permit applications. Furthermore, it is not required by the Metal Mine Reclamation Act. Rather, such issues are addressed by the agencies in complying with NEPA and MEPA--in this case, the environmental impact statement. The agencies' draft EIS, contrary to NPRC's claim, does address the list of "significant areas of concern and controversy." Please refer to pages I-4, I-8, I-12, II-95 to II-97, II-67 to II-71, IV-1, III-5, III-6, III-12, III-7, III-21, VII-14 to VII-16 and elsewhere in the draft. These issues are further discussed in the final EIS in response to agency and public comment.

B Both the application and DEIS addressed the power corridor to the extent Montana Power Company provided the agencies with information. Both the DEIS and application noted that the power corridor would be parallel and adjacent to

LETTER 32

to include roads, utility corridors and final processing facilities design in the application process and DEIS? Will the agencies and JJV commit to having the above mentioned concerns addressed in the Final EIS?

We have been reassured by the agencies that JJV will not begin construction until all proposed stipulations are complied with. Will the affected public have the opportunity to comment after all these questions and mitigation measures are addressed?

SOCIO-ECONOMIC CONCERNS

C The already approved hard rock impact plan for the JJV concludes that there will be no significant impact to the Jardine and Gardiner areas. This is based on the assumption that a majority (80%) of the work force will be hired locally. This assumption is used because of JJV's comitment to hiring and training local workkers. We do appreciate that comitment from JJV. There are a few questions that need to be answered though. First, on what is this assumption based? Does the number of unemployed automatically translate into a workforce with the skills and backgrounds conducive to working for a hard rock mine?

What steps has the JJV taken to further this comitment to hire locally? Have representatives of the JJV talked with any of the recently laid-off BN workers or their labor representatives? Has a training program been prepared and presented to any of the potential "local" employees? We are deeply concerned with the accuracy of employment projections predicting that 80% of the work force will be local. If the projections are not accurate, would the finding of no significant impact be a valid conclusion?

D On p. II-75 DEIS, the statement is made that"many Gardiner businesses are operated by absentee owners who only participate in the community during the summer". What percentage or number of these businesses is meant by many? We disagree with this statement and ask how the State reached such a conclusion?

E We would like to ask a question of clarification. If 80% of the work force is intended to be local, then how will up to 50% of construction income be paid to non-local workers?(DEIS p. II-48)

F It is stated in the DEIS p. III-57, that the Park County Sheriffs Department and Park County citizens believe that an additional deputy will be needed once the mine opens. A deputy has recently left the area. Would JJV be willing to fund this position?

G The location of the mill and processing facility in the heart of Jardine and increased vehicular traffic would seem to increase possible fire danger. What will JJV commit to as far as providing fire protection to Jardine area residents?

H The DEIS assumes that the non-local migrating workforce will be able to move into existing and available housing units around Gardiner. What impact will this have on seasonal visitors,

the county road from Gardiner to Jardine (see pages I-8 and III-34). Additional information concerning the construction and location of the power line is included in the final EIS (see Chapter I and IV). DSL has authority to require the applicant to identify the location of proposed roads and utility corridors pursuant to 26.4.107 ARM. Final design of processing facilities (mill) however, are not required. Final design of such facilities are normally initiated after the company has completed its feasibility study and has received regulatory approvals. These concerns were addressed in the draft EIS and are clarified in the final EIS.

Public comments on the final EIS would be considered by the Forest Service and DSL. However, note that the Forest Service normally issues its record of decision with the final EIS. The decision by DSL can be made no sooner than 15 days following issuance of the final EIS.

C The JJV has committed to hire 80 percent of its work force locally. The JJV believes the goal to be realistic because skill characteristics of employees laid off by the Burlington Northern as of 1984 and of some unemployed people registering with the job service in Park County would be compatible with skills needed by employees of the JJV (Mountain International, Jardine Joint Venture Hard-Rock Impact Mitigation Plan, 1984, Tables 6-10 pp. 33-38). Not only are skilled people available, but the JJV has committed to training employees as well. Park County has had an unemployment rate consistently higher than the statewide average over the last five years. The opportunity to have a steady job may outweigh any negative considerations that some unemployed workers may have about working in or at a mine.

The JJV has not contacted BN representatives or laid-off workers. The JJV would provide on-the-job training by skilled supervisors. If the JJV does not hire 80 percent of the work force locally, impacts of in-migration may be different than predicted in the EIS. If the majority of newcomers to Park County resided in Livingston, hiring nonlocal people would not cause impacts significantly above those predicted in the EIS. Livingston has adequate housing to absorb over 100 families, particularly if recently laid-off Livingston BN workers accept transfers to other locations. If newcomers were to settle in Gardiner or Jardine in greater numbers than currently anticipated, impacts could be different than predicted. Increased impacts to government services could be mitigated through amendments to the hard-rock mine impact mitigation plan, if two years have not elapsed since the start of production.

D A survey of Gardiner-area residents was made in 1981 and updated with key-informant interviews in 1985 (Chapter II--Sociology, Social Life). The adjectives "large share" and "many" can be interpreted to mean greater than 25 percent of Gardiner businesses. The data collected from the survey and interviews indicated that many area businesses are operated by absentee owners, especially during the summer when tourism in Yellowstone Park is highest. In addition, the Jardine Area Project Socioeconomic Impact Assessment, volume I, written by Mountain International, Inc., 1984, states on p. 74 that "absentee owners operate a large share of Gardiner businesses and generally participate in the community on a limited basis." This study was prepared for the JJV, submitted as part of the mine permit application, and can be reviewed at the Department of State Lands in Helena. The adjectives "large share" and "many" can be interpreted to mean one-fourth to one-half of Gardiner businesses.

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E The reference to nonlocal workers' share of construction wages is in Chapter III--Income. Pay varies according to skill levels required to do a job. Nonlocal construction workers may be paid proportionally more than local workers, as they may be more likely to receive jobs requiring highly specialized skills that cannot be acquired in a short amount of time. An extreme-case scenario, unlikely to occur, is that nonlocal workers would receive up to 50 percent of construction wages, although comprising a proportionately smaller percentage of the work force.

F The "Jardine Joint Venture Hard Rock Impact Mitigation Plan for Gardiner and Park County, Montana" identifies the JJV commitment to provide tax prepayments to offset law enforcement impacts (p. 94). The JJV has agreed to provide $15,000 between 1986 and 1987 for the purchase of communication or other law enforcement equipment for southern Park County. If necessary, the JJV would issue press releases to discourage job seekers from coming to Park County which may help alleviate potential law enforcement problems related to transients. There is no agreement by the JJV to fund a deputy position. It should be noted that commitments made by the JJV in the hard-rock mine impact plan are generally in the form of tax prepayments. Such expenditures would be deducted from future project tax bills; appropriations to continue funding any increase in law enforcement personnel would be made by the county commissioners. If the county were to experience greater law enforcement impacts than anticipated, the county could petition the Hard-Rock Mining Impact Board to amend the plan if it becomes apparent that the plan is materially inaccurate and two years have not elapsed since the date that the project begins commercial production (MCA 90-6-311 [1][b]).

Most Gardiner-area residents who were interviewed or who responded to a survey believed that two additional deputies would be needed in the Gardiner area. One deputy is believed to be needed now and an additional one after the mine has opened.

G The JJV would provide its own onsite fire protection for surface and underground equipment. The JJV would pay an annual fee to the Gardiner Fire District for manpower and equipment support in fire suppression, but the JJV would not join the district (Mountain International, Inc., Jardine Joint Venture Hard Rock Impact Mitigation Plan for Gardiner and Park County, 1984, p. 98).

As noted in the DEIS (Chapter III--Sociology, Community Services), Jardine residences would not be covered by the agreement between the JJV and Gardiner Fire District. Jardine residences would be at additional risk due to the possibility of mine fires; however, these residences are already without fire protection.

The Gardiner Fire District could extend its boundaries to include Jardine. It is not known if the district would pursue this action. The JJV has not committed to providing fire protection to Jardine either.

H It is difficult to predict the exact nature of potential housing impacts. Impacts would be influenced by the number and timing of tourist visits, the number of seasonal workers without access to company-sponsored housing, and the number of mine employees choosing to live in Gardiner. However, the

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tourists or the seasonal workforce?

I On p. III-62 DEIS it is noted that JJV will "confer" with agencies to "insure" that temporary garbage facilities are bearproof. Does this mean that JJV will provide the funding for bearproof containers? If not, what does it mean?

J On p. III-62 DEIS, it is stated that "it is not known at what prices the project would be profitable". This statement is somewhat incredulous. Does this mean that JJV has no idea, no price range or bottom line for the price of gold in order to operate at a profit? Along another vein, in the past secondary or by-products of mining gold in Bear Creek have proven to be just as profitable as gold mining. Does JJV have any intention of mining and processing anything other than gold? Also, how far along are JJV's plans for exploration and possible mining in the Crevice Mountain area?

K Speaking of finances, we are also concerned with the proposed method of financing the "preferred " road alternative. Doesn't the Hard Rock Impact Act require developers "to pay all increased capital and net operating costs to affected local government units"? We feel that the proposal by JJV to provide approximately $500,000 to Park County in the form of tax prepayments violates the intent, if not the letter of the Act. To the best of your knowledge, will the County commissioners accept this form of payment?

Whichever way the road is financed, we still request that a detailed comparative analysis be made available for public review and comment prior to a final route selection and permit approval. Will the agencies and JJV commit to this?

L There are several mitigating measures to offset road related impacts suggested on p. III-70,71 DEIS. Will all of these be required stipulations? If not, why not?

M Has the JJV worked with either DSL or the Montana Historic Preservation Office to develop a mitigation plan for the Jardine Historic District?(DEIS p. III-73) If not, will they be willing to do so? We commend and agree with the proposal to access the town of Jardine by avoiding as much of the historic district as possible. Will the agencies require JJV to adopt the cultural mitigation measures as proposed on p. III-73 DEIS?

N It is noted in the DEIS that background noise has not been monitored in the Jardine area. In order to insure that the JJV has an accurate baseline assessment, we request that this be done prior to the commencement of construction if a permit is granted. Will JJV agree to do this? What standards will be applicable and applied to reduce noise during construction and operation?

WATER RELATED ISSUES AND CONCERNS

O On p. III-5 DEIS, it is noted that water withdrawals from Bear Creek could "potentially" impact the amount of water available to maintain instream flows. With this in mind, JJV's water withdrawel becomes a significant concern. On what did the

Gardiner area is already subjected to large fluctuations in housing demand due to Yellowstone National Park and big-game hunts.

If housing demand exceeded the supply, short-term impacts could include inconvenience and housing price increases. As the private market responds and residential facilities are built, market prices may decline and inconvenience would be near levels normally experienced due to fluctuations in tourism.

I The applicant has committed to "bear-proofing" garbage facilities in the permit area.

J The statement that it is not known at what gold prices the project would be profitable means that DSL does not know this information nor has DSL requested such information from the JJV.

The JJV would refine gold from the ore. Other metals, although present, occur in such small amounts that it is unprofitable to recover them.

Information on company exploratory activities is proprietary. The JJV has officially commented that any future mining activity in the Crevasse Mountain area "would require additional regulatory approval and opportunity for public input" (Dick Agar, Vice President, Manager-USA, American Copper and Nickel Company, Inc., pers. comm., January 23, 1986, p. 34).

K The Hard-Rock Mine Impact Mitigation Act states that the developer shall commit itself to pay all increased capital and net operating costs that local governments experience as a result of the mine project. These payments can be in the form of tax prepayments or other methods as identified in MCA, 90-6-307(3).

The provisions of the Park County hard-rock mining impact plan are subject to statutes in effect before the 1985 legislative session when the act was amended. Prior to those amendments, the act contained specific language and a formula for determining the amount of tax prepayment that would be credited or rebated to the developer after the start of project production (MCA, 90-6-309[4] and [5]). Therefore, tax prepayments violate neither the intent nor the letter of the law.

The Park County Commissioners negotiated the final provisions of the hardrock mining impact plan with the JJV. The commissioners' approval of the plan would indicate that they would accept tax prepayments to fund impact mitigations.

Detailed engineering, biological, and geological analyses would not be made before the permit decision. The Jardine Road is the superior alternative because the JJV has committed to a traffic reduction plan and to funding improvements to the road. These mitigations greatly reduce the public hazard due to mine traffic and to other users of the Jardine Road. If an alternative mine access road were constructed, the Jardine Road improvements would not be undertaken as outlined in the hard-rock mine impact plan. Furthermore, mine traffic could still use the Z-Hill Road. Constructing an alternative access would not mitigate the most significant impact--increased hazard on the Z-Hill Road, due to mine traffic (see letter 16, response B).

LETTER 32

L The carpooling and road improvements mitigating measures in the transportation section (Chapter III) are commitments that the JJV made in the approved hard-rock impact mitigation plan. In addition to these measures, after the agencies published the draft EIS, the JJV further committed to additional measures to reduce traffic impacts on the Jardine Road. These new measures, some of which include carpooling, financial incentives, bussing and limiting parking at the minesite are described in detail in Chapter I. The JJV's commitments meet the objectives of the bussing, park and drive, and traffic reduction mitigating measures described in the draft EIS.

M The JJV submitted with its application a Cultural Resources Inventory and Evaluation Report and a Cultural Resource Impact Assessment and Management Plan for the Jardine project. Both reports were evaluated by the State Historic Preservation Office and the Forest Service.

Because the JJV has proposed to use the existing bridge and road to access the mine, the agencies have dropped the alternative mine access roads from the final EIS. The JJV's new proposal would avoid removing the 5 historic structures that would have been destroyed by the earlier proposal.

The mitigating measures listed in the draft are included in the JJV's revised project plan. The JJV has committed to the recommendation of the mitigating plan.

N The JJV has agreed to measure background noise levels before mine construction, should a permit be issued. The noisy compressor, which has been the subject of many complaints from Jardine residents, has been replaced with a much quieter one. The mill and crusher buildings would be insulated to lessen noise. Little can be done to eliminate construction noise; however, the applicant has committed to maintain all equipment to avoid excess noise levels. After construction is complete, noise levels should reach background levels within 300 to 600 feet from the mill.

O Please refer to the responses to letter 10, comment G; letter 13, comment O; letter 17, comment B; letter 20, comment B; letter 20, comment U; letter 20, comment V; letter 25, comment D, as well as Appendix 17. The JJV has also committed to maintain a minimum instream flow to protect Bear Creek aquatic life.

LETTER 32

applicants base their claims? Why did they claim so much more (approximately 6000 times according to the DEIS), then they propose to use? Will the agencies require, and will JJV commit to maintaining an instream flow sufficient to protect the Bear Creek fishery and agricultural and domestic water supplies?

P It is unclear where water for the project will be withdrawn. The DEIS suggests on one hand that all the water needed will be withdrawn from Bear Creek, and then later mentions that water will be withdrawn from Bear Creek, Pine Creek or a deep water well. Which will it be, and where?

Q The DEIS on p. I-7 notes that if recycled water is high in total dissolved solids(TDS), then two sludge ponds will be constructed between the embankment and seepage collection ponds. Isn't it fairly certain that the recycled water will be high in TDS? If so, we request that the exact location, size and volume of these ponds be included as a permit requirement. Will DSL require this?

R In order to partially address our concerns over water availability and to minimize impacts to Bear Creek during low flows, would JJV build a storage facility for water to be used in case of drought conditions or an emergency(such as a fire)?

S On p. III-12, the DEIS mentions several mitigation measures to control erosion. We urge the adoption of these as permit stipulations, and ask if the JJV will be willing to commit to them?

T The DEIS suggests that "all wastes associated with the more toxic sulfide flotation should be disposed of in the liquid tailings dump" DEIS p. III-14. Will this be a permit stipulation?

U It is assumed that the "tailings produced by the proposed operation would be chemically and physically similar to existing tailings". How was this assumption arrived at? Were the same reagents and processes used to produce the existing tailings as will be used by JJV? Would weathering have an impact on both the chemical and physical properties of the tailings? We are concerned that if the assumption is not valid, then proposals for reclamation and revegatation will have to be reavaluated.

V It was unclear to us how the tailings that will be used to back-fill the mine will be transported. Where was this discussed in the DEIS? It is inferred that they may be moved in a pipe similar to that used to transport the tails to the disposal site. How will this pipe(if a pipe is used) be protected against rupture? What will be proposed to assure that in case of a spill or rupture that surface and groundwaters will be protected? We feel that just a detection and shutdown system is inadequate. Will a lined ditch be used as a back-up to contain a possible spill?

P The JJV proposes to upgrade the existing Pine Creek water source to provide water to the project. The Pine Creek point of diversion, as described in Appendix 23, consists of an infiltration structure in Pine Creek which feeds a 4-inch line to the project. The infiltration structure is approximately 30 feet in circumference. The 4-inch line from the infiltration structure goes into a 3,000-gallon, buried holding tank, which provides a constant head to the project site. The existing system provides a flow rate of approximately 50 gpm.

This system would be upgraded by improving the infiltration structure and installing a 6-inch buried pipeline. A 60,000-gallon storage tank would also be in place to provide surge capacity. This system would be capable of providing a flow rate of approximately 500 gpm.

A secondary water source would consist of placing a portable pump in Bear Creek. A pump with approximately 600 gpm capacity would be used. The source would be employed as an emergency backup only. The secondary source would not require the installation of any permanent structures.

Q Information regarding design details of the proposed sludge ponds are presented in Appendix 16. Also, please refer to letter 20, comment R.

R The JJV's revised water use requirements are as shown in the following table:

Use	Peak Use	Peak Consumption
Mine		
Sand Fill	22 gpm/0.05 cfs	11 gpm/0.03 cfs
Drilling	6 gpm/0.01 cfs	6 gpm/0.01 cfs
Diamond Drilling	5 gpm/0.01 cfs	6 gpm/0.01 cfs
Mill		
Operations	200 gpm/0.45 cfs	12 gpm/0.03 cfs
Tailings	145 gpm/0.32 cfs	6 gpm/0.01 cfs
Potable	5 gpm/0.01 cfs	5 gpm/0.01 cfs
Dust Control		
Roads	300 gpm/0.67 cfs	150 gpm/0.33 cfs
Waste Rock	42 gpm/0.09 cfs	42 gpm/0.09 cfs
Irrigation	10 gpm/0.02 cfs	10 gpm/0.02 cfs
Fire Protection	1,000 gpm/2.22 cfs	1,000 gpm/2.22 cfs
Contingency @ 20%	347 gpm/0.77 cfs	249 gpm/0.55 cfs
TOTAL	2,082 gpm/4.62 cfs	1,496 gpm/3.31 cfs

LETTER 32

The peak water consumption shown above is biased by the need to have at least 60,000 gallons (1,000 gpm) available for fire protection. However, a storage tank of at least 60,000 gallons capacity would provide adequate surge capacity in the event of a fire.

S Please see letter 6, response A and Appendix 14.

T After the publication of the draft EIS, the JJV committed to disposing of the cyanide circuit solids (sulfide concentrate) in the lined tailings dump (refer to Chapter I--Tailings Disposal).

U This assumption was made because the old, historic tailings were produced from ore taken from a mineralized zone that is similar to the one that would be mined by the JJV. No plant-available chemical analysis is available for the tailings that would be produced by the proposed operation; however some total analyses values are given in the application (see Appendix 1). DSL feels that the analysis of the historic tailings presents a worst-case condition because these tailings have been exposed to oxidation and weathering processes for several decades. This assumption is substantiated by the fact that many of the plant-available values for the historic tailings are greater than the total values for the proposed tailings. No information is available on the reagents used in past operations at Jardine. Weathering certainly affects the chemical and physical nature of the tailings material. The proposed reclamation plan was determined to be sufficient even under worst-case conditions. JJV's tailings would not be subject to oxidation and weathering for extended periods. Please see the discussion in Chapter III--Soils, Tailings Dump.

V Please see letter 20, response BB.

In addition to slurry flow control, ditches and ponds are available for physical containment in the event of a spill from the slurry or return water pipelines. The 2 foot by 2 foot containment ditch described in the Operating Permit Application would provide a volume of 400 cubic feet or 2,992 gallons per 100 feet of length. This is 20 times the volume of 100 feet of pipe in operation.

The sand backfill line would operate one shift per day. A special crew would be assigned to this task; the crew would also maintain the line when not in use. When in use, the line would be continually patrolled.

In addition, containment ponds would be located at the base of the hillside between the mine and the mill, and at the mill. These containment ponds would be sized with sufficient capacity to completely contain a spill in the entire reach of pipeline upgradient from the pond. A pump would also be activated in the containment ponds in the event of a spill in order to return the slurry to the mill, allowing time for only minimal seepage.

p. 5 BCC & NPRC comments

LETTER 32

W JJV proposes that tailings with a 15% moisture content will both solve a saturated tailings problem while preventing tailings from blowing. How was this percentage arrived at? Are there any other exising hard rock facilities that have obtained and maintained a 15% moisture capacity as proposed by JJV? How will JJV prevent snowmelt or precipitation from entering and infiltrating the dump and upsetting the moisture content?

X We would like to suggest that DSL require JJV to build a tiered or terraced external tailings embankment to help reduce erosion and enhance revegetation. Hasn't Homestake already employed this method in Colorado? Will DSL be willing to make this a permit requirement?

Y Will the mill and all other facilities be built to withstand a major seimic event? To what degree or level of event?

Z Will a lined emergency spill ditch under the slurry line be required as a permit condition or stipulation?

AA The DEIS concludes that the Bear Gulch fault is probably inactive. How was this conclusion reached?

We feel that the whole discussion of possible earthquake activity and impacts to the project were treated a little lightly. For example, the DEIS concludes that an earthquake of around 7.3 on the richter scale would cause considerable damage. It then indicates that this is not a concern because "such a large event would probably occur about once every 10,000 years." How was this conclusion reached? Is it possible that we are at year 9,998 of that 10,000 as opposed to year one?

BB Has there been any indication that water bearing strata might exist below the proposed 450 level of mining? We are concerned that if this the case, then the 40% of the tailings that will be placed at the 450 level could constitute a hazard. Isn't there a hydraulic connection between the bedrock aquifer below the 450 level and the Bear Creek alluvial deposits? Is it possible that tailings seepage could enter this system?

CC At the public hearing, members of Bear Creek raised several questions concerning the septic drain field and we would like to reiterate them.

What alternatives to the proposed location were considered? Why was this location choosen?

DD A mill and processing facility would produce liquid wastes other then those in the benificiation process. We ask why DSL at the public hearing stated that "there are no environmental impacts associated with the mill"? Besides noise and air pollution questions, there will be lubricants, cleansing solutions and other industrial by-products that are usually transported out of a facility in a liquid form. A mill is usually flushed

W Extensive experience with methods of dewatering fine-grain materials exists in both the mineral processing and waste disposal industries. Uranium waste, for example, which is generally a finer-grained material than the expected tailings product at the Jardine Joint Venture, has been successfully dewatered to a moisture content of less than 20 percent. The exact process that would be used to dewater the tailings at the Jardine Joint Venture has not been finalized and would depend on the evaluation of the performance of various types of equipment. The moisture content achieved by equipment such as centrifuges, belt presses, disk filters, and drum filters depends on the gradation and clay content of the material. The Jardine tailings are of low plasticity and contain littleto-no clay particles. Discussion with the manufacturers of dewatering equipment and a review of equipment literature, indicates that a moisture content of 15 percent can be obtained. This moisture content would correspond to saturation of approximately 50 percent.

Should the moisture content of the dewatered tailings vary--for example, to 20 percent--the tailings would remain in an unsaturated state at the assumed placement density. The effect of an increase in moisture content would be some unsaturated flow from the tailings. This drainage would be collected in the engineered drains within the facility and routed via the collection pond to the plant. The capacity to recycle the additional volume of water which may result would be included in the return system. Under self drainage, it is anticipated that a field moisture or residual moisture content of approximately 15 percent would be achieved.

Appendix 19 presents information regarding dewatering precious metal tailings.

Snowmelt and precipitation would be controlled by the finger drain systems in place above the synthetic liner. The design details of the impoundment are presented in Appendix 16.

X Based on our evaluation, the agencies do not feel that such a requirement is warranted. Erosion is not expected to be a significant problem on the embankment slopes.

Y Mitigating measures in the final EIS require that the mill building return water pipelines be built to specific earthquake design criteria (see Chapter III--Geology, Mitigating Measures). The company has committed to several design criteria for the tailings/return water pipelines which would minimize the chances of pipeline failures and significant leaks (see Chapter I).

Z Safety devices incorporated at the mill which would automatically shut down the slurry and return-water line systems would significantly limit the volume of liquid contaminant (see Chapter I). Lining of the ditches would not be required.

AA You are correct in pointing out that earthquake frequency estimations express the average time between earthquakes and should not be used to predict the exact timing of a future event. However, because the recurrence interval is roughly 10,000 years for the maximum earthquake in this region, the chances of such an event over the 20-year mine life is extremely small. A large earthquake near the minesite could easily shut down the mine and mill until repair work could be accomplished. All facilities dealing with tailings or tailings slurry water would be designed to withstand strong ground shaking. (Also see response to public testimony 3C and Chapter III--Geology, Mitigating Measures.)

BB Please refer to letter 19, response G.

CC Please refer to letter 6, response D.

DD Please refer to letter 14, response A.

p. 6. Bear Creek & NPRC comments

LETTER 32

down and cleaned and this water goes somewhere. We'd like to know where?

EE Also, what potentially toxic or hazardous materials or substances will be on site besides those listed in the DEIS? Where will liquid & solid industrial waste be deposited? Will anything other than domestic sewage enter the septic drain field? We request that all residual industrial waste be either placed in the tailings dump, or that a suitable disposal proposal be presented for review. Will the agencies stipulate this and will JJV commit to doing it?

Wildlife

FF We challenge the adequacy of the baseline data presented in the DEIS. This year and the years on either side of the sample year would show significantly higher numbers of wildlife. Will the agencies do a comparison of years other than the single year submitted as baseline data?

By stating in the DEIS that no big game were spotted in developed areas, were the agencies concluding that big game don't frequent these areas? If so, we disagree.

GG The DEIS mentions concern over possible wildlife poisoning from ingestion of toxics. We request that any impoundment or area where potentially toxic or hazardous materials are present be fenced to prevent wildlife encroachment and possible poisoning. Will the agencies require this as a stipulation?

HH What will JJV do to expand tailings disposal capability in the event more than 20 years worth of ore is discovered?

Reclamation

II According to the DEIS, the tailings pond is to be reclaimed in stages. What is the proposed reclamation plan if the mine shuts down either temporarily or prematurely? We are concerned that if either situation occurs, JJV would have to come up with a reclamation plan, which would then have to be approved by DSL and the USFS and then implemented. Instead of having a time lag between the time such a shutdown occurred and a plan was implemented, we request that DSL require JJV to prepare and submit a contigency reclamation plan. Will DSL request this of JJV, and will JJV commit to this?

JJ The DEIS notes on p. III-18 that post mining water and nutrient holding capacities are expected to be adequate for revegetation, especially in areas where soils are hauled directly. It then notes that only 55% of the soils will be hauled directly. Does this mean that 45% of the soils will not be adequate for reclamation after storage? Is there any way to lessen the amount of soils to be placedi in storage?

EE The laboratory at the proposed JJV project would process approximately 50 samples by fire assay per day. Each sample would be approximately 300 grams in size. Chemicals used in the fire assay methods would be litharge (PbO_2), silica, borax, and potassium nitrate, to form the flux. Following the initial fusion with the sample, the major constituents of the flux report to the silica slag, which becomes a solid waste product and can be disposed of in the tailings. In the second state of cupelling, the lead is absorbed into the cupel and becomes a solid waste product. The final stage of the fire assay process consists of dissolving the silver from the precious metal bead with nitric acid. Approximately 20 milliliters of acid are used for each sample. The used acid would be processed through a neutralizing tank and the liquid waste entered into the mill circuit.

Also, please refer to letter 14, response A.

FF Except for information on waterfowl (see revised text), additional baseline data would not be included in the final EIS. The elk and mule deer subsections (Chapter II--Wildlife) briefly discuss studies conducted outside of 1981-1982. The grizzly bear subsection (Chapter II--Threatened and Endangered Species) contains information from a wide range of years. Additional data is available only for elk. This data indicates that elk winter range (figure II-37) does not vary substantially among years (Jon Swenson, Montana Department of Fish, Wildlife and Parks, pers. comm., January 24, 1986). The numbers of elk and other species in the study area undoubtedly fluctuate among years. However, these fluctuations would not change the impact analyses.

The sentence to which you refer supports the preceding statement evaluating the significance of removing developed areas. We do not consider developed land to be important wildlife habitat.

GG The permitting agencies would require fencing around the return-water pond. The applicant now proposes to fence the seepage-collection pond. The tailings dump would be monitored for elk, deer, and grizzly bear use. If these species are consistently in the dump area, appear to be consuming tailings, or show signs of poisoning, a fence would be required.

HH The agencies do not know of any plans by the JJV to expand the tailings disposal facility. Any change in the tailings disposal facility design, including to increase capacity, would require an amendment of the operating permit and approvals by the regulatory agencies.

II If the mine is closed and abandoned, state law would require reclamation within 2 years. Reclamation that follows the applicant's 1984 plan would be sufficient. During a temporary closure, the applicant would adhere to all requirements of the permitting agencies. These requirements would include meeting water quality standards and controlling erosion. The mine site would be inspected regularly by the Department of State Lands and Forest Service.

JJ As the sentence you refer to states, postmining water- and nutrient-holding capacities are expected to be adequate. This is especially true where soils are direct-hauled. This does not mean that 45 percent of the soils would not be adequate for reclamation, and this is not stated in the EIS. There is no way to significantly lessen the amount of soils to be placed in storage.

LETTER 32

p. 7. BCC & NPRC comments

KK The DEIS assures us that residual cyanides would be harmless to revegetation, in part due to its bonding with iron. Will this bonding be affected by weather or oxidation?

LL Will JJV commit to putting a "tackifier" or erosion control product on its hydromulched areas? Will the agencies make this a stipulation?

Air Quality

MM We would first like to state our concerns with the adequacy, and accuracy of the baseline data on wind speed and direction. We have drawn to DSL's attention, pictures and numerous comments from area residents that seem to contradict the conclusions reached in the DEIS. How do the agencies explain this discrepency?

NN We question the accuracy of the Total Suspended Particulate(TSP) count. Weren't samples only taken once every six days? Is this considered Best Available Control Technology(BACT) in monitoring? Canthis kind of monitoring be done on a daily basis? If so, we request that the Air Quality Bureau or DSL require this kind of monitoring to be set up on a continuous basis. We request this because we are worried over possible levels of arsenic in the air. Have levels of arsenic been detected in background or baseline monitoring? If so, we request that trace chemical capabilities be included on all monitors. Will the agencies agree with, and JJV commit to these mitigation requests?

OO What kind of "chemical stabilizers" are being referred to when they are discussed as a possible air pollution mitigation step? What, if any, are the biologic or environmental concerns associated with such stabilizers?

Assuming that they are environmentally benign, would putting a chemical stabilizer on the tailings further reduce the possibility of tailings blowing? If so, then we request that this be a permit stipulation. The application of a stabilizer would not only lessen a potential air pollution problem, but would serve to keep tailings from blowing on new vegetation, thereby enhancing vegetation and reclamation success. If in fact it would further control tailings dispersal, is there any reason JJV would not use it?

PP We question the consistency in the application of BACT in the control of fugitive dust emissions. The DEIS notes that the use of chemical stabilizers can result in a 85% control factor while using water would result in about a 50% control. Why then does JJV propose to use water during construction but chemicals during mining? We suggest that the BACT be applied in all cases during construction and mining. Will JJV commit to this?

Hydrologic Mitigation

QQ Besides the mitigation measures that we have proposed in our comments, we would like to state our concurrence with those measures mentioned in the DEIS p. III-12,13. Does the DSL propose to require all of these as stipulations? We urge them to do so, and would ask JJV why they wouldn't agree to the whole list?

KK To a small extent, yes. However, this issue should be placed in perspective. Very little weathering would take place in the proposed tailings dump since very little of the tailings would be exposed to air for prolonged periods. In addition, other chemical and biological processes (in addition to binding with metals) would take place that would break down or transform most of the minute amount of residual cyanide in the tailings to relatively harmless compounds. Please read the discussion in Chapter III--Soils, Tailings Dump.

LL The JJV has not committed to using a tackifier on hydromulched areas. The agencies would not require the use of a tackifier at this time. Although the slopes are steep, the waste rock dump would be small in size (approximately 2 acres or less). While a tackifier would increase the effectiveness of the mulch, the mulch itself may not even be necessary for successful reclamation because 1) slope lengths are short, 2) soils are coarse, 3) infiltration would be high, and 4) runoff would be low. Should erosion become a problem, the agencies could require addition of a tackifier or any other cultural treatment to reduce erosion.

MM The main question concerning the wind speed and direction appears to be the wind direction frequency. The data indicate that a slightly higher frequency of wind was downvalley (from the northeast and east-northeast) as opposed to upvalley. Area residents report that dust plumes eminating from the old tailings pond are exclusively from up-valley winds. The probable reason for this is that the up-valley winds would, in some cases, be associated with weather systems generating high wind speeds while the down-valley winds would most often be slower drainage winds occurring in the evening and night. Although the down-valley flows occur more often, the short-term, higher-intensity, up-valley flows would be more likely to generate wind-blown tailings. DSL feels that the baseline wind speed and direction data accurately and adequately represent the wind regime in the area.

NN TSP samples were taken on the Environmental Protection Agency's one-in-six day schedule. This is the most common frequency for TSP sampling. The frequency of sampling can be greater and could be continuous if more samplers were used. The one-in-six day schedule is statistically valid over time. With an intermittent and random emission source like blowing tailings, a number of days with high emissions would be missed. Those sampling days when high emissions are occurring would cause the average to be correct if the overall sampling time is long enough. The term Best Available Control Technology (BACT) is not normally applied to monitoring programs. The baseline air monitoring effort and the required operational air monitoring program has been developed by the Air Quality Bureau in an effort to be most reasonable with respect to committing JJV resources while providing adequate air quality information. The monitoring requirements are included in the Preliminary Determination on the JJV air quality permit application.

Additional information on airborne arsenic levels from the baseline monitoring program has been added in Chapter II. Trace element analysis, including arsenic, would be performed on all samplers as a requirement of the air quality permit.

OO There are many different types of chemical stabilizers available. General types include salts that attract and retain moisture, adhesives and bitumens that are mixed with the existing surface layer to form a new surface, and polymers that form a film over the surface. The stabilizer used on the old tailings area was a biodegradable polymer. The Air Quality Bureau does not specify the type of stabilizer which must be used. Generally, companies would evaluate various products for their specific situation. If the stabilizers are properly applied (according to manufacturer's specifications), there should not be biological or environmental problems associated with their use.

The air quality permit requires the installation of a sprinkler system or equivalent mitigative measures, if necessary, to control wind-blown emissions. The JJV has indicated that chemical stabilization would be preferable if determined necessary by the Air Quality Bureau. The reason the requirement is on an "if necessary" basis rather than a definite condition is because it is difficult to determine beforehand whether the active face of the new tailings would be susceptible to wind erosion. Stabilization of the old tailings area would be required until it is incorporated into the new tailings.

PP The definition of Best Available Control Technology (BACT) takes economics into account. Because construction activities are generally short term, it may not be cost-effective to apply chemical stabilization. If the frequency of watering is adequate, the control efficiency would be similar to chemical stabilization on a short-term basis.

QQ Please refer to Chapter I--Preferred Alternative--for the list of mitigating measures that the agencies would require.

LETTER 32

p. 8. BCC & NPRC comments

Utilities & Power supply

RR During the course of the public hearing on the project, the hearing officer stated in response to a question on a possible utility corridor, that he felt that the State had enough information upon which to base a decision. At the time of the public hearing, what information did the agencies have concerning a possible utility corridor route? We were particularly concerned with this statement since an analysis of impacts didn't appear in the DEIS.

We have several problems with the way this issue hasn't been treated. We have been told in conversations with JJV officials that "if a new line is needed, it would probably be buried along the county road". The DEIS seems to indicate that it will be an above-ground line along the county road. Which will it be? Is there an easement that goes along with the existing line? If so, why not use the existing corridor? Will a new easement that goes along with the new line be needed? Does MPC or JJV have the right to condemn for a right of way if it is needed?

Does the State and USFS agree that this issue has the potential to be controversial? And, that major questions exist concerning this subject? Do the agencies agree that this line is an associated facility of the JJV project? (it wouldn't be built without a mine and processing facility, would it?) Shouldn't it be included in the same application and DEIS reveiw process? Do the agencies feel that the Major Facility Siting Act is the controlling statue in this situation? If not, who is going to be responsible for mitigating impacts?

We feel strongly that a discussion of alternatives and possible impacts and mitigation be included as part of the mine permit process. Without the mine, there would be no line. Will the agencies require and JJV commit to including this discussion prior to permit approval?

SS In closing, we reiterate our objection to the review of a "conceptual permit application". We ask again, why some of the more controversial and significant aspects of this project have not been made available, up front, for public review and comment?

Members of the Bear Creek Council are among those who will be most directly impacted by the Jardine Joint Venture. To date, we have not opposed the project. We urge the consideration and adopttion of those measures that we have suggested to minimize impact. We also request that those major areas of impact and controversy, that have not been included in the analysis, be included prior to permit approval.

Respectfully submitted,

Sue Johnson
Sue Johnson
Bear Creek Council, President

Russ Brown
Russ Brown
NPRC Staff

RR The agencies were told by the Montana Power Company (MPC) that a new 69-kV transmission line would have to be built to serve the electrical needs of the mine and processing facilities. The most reasonable location identified by the MPC would be parallel to the existing road from Gardiner to Jardine. MPC noted that the existing line would be difficult to maintain because it is in extremely rugged terrain. Potential environmental impacts of the power line (possible raptor electrocution) were noted in the draft EIS.

MPC described the new power line to be an above-ground facility consisting of "single-pole structures for the most part but may use H-frame type construction where necessary to meet long span requirements." The power line would not be buried. MPC would have to acquire easements from landowners to construct the power line. Easements would be needed for federal and private lands. Easements could be acquired by condemnation if absolutely necessary.

Public comment on the draft EIS has identified the location of the power line corridor to be a concern. The concern was not well defined during the initial scoping meeting held before the agencies began their preparation of the draft EIS (see Introduction--Issues and Concerns).

The utility needs of the proposed project were addressed in the draft EIS and in the JJV's application. Additional information including alternative power line corridors is included in the final EIS (see Chapters I and IV). The new power line would be a 69-kV facility and would be less than 10 miles in length. As such, construction would not require state approval pursuant to the Major Facility Siting Act (MFSA). Easements for right-of-way on national forest lands, however, would require a specialuse permit from the Forest Service.

SS See response A.

TESTIMONY 1

JARDINE JOINT VENTURE
PUBLIC HEARING
December 3, 1985

BILL HOPPE:

A My name is Bill Hoppe. My family lives and operates our outfitting busi-
ness south of Jardine. We are members of the Bear Creek Council. We also
have children in Gardiner Elementary School and have a strong interest in
Gardiner and Jardine areas. As it has already been stated, we are not opposed
to the orderly development of Jardine Joint Venture. We are, however, con-
cerned that this development doesn't negatively affect our ability to conduct
our business. While we will be submitting detailed written comments, there
are a few points I would like to make that concern the Joint Venture impact on
wildlife habitat and proposed mitigations. We feel that 1 year, 1982, of
B baseline information is inadequate to come to any realistic conclusions as far
as wildlife population or habitat use is concerned. The 1982 study year was
an extremely open year. If you were to do the same wildlife counts in a few
weeks I am convinced that you would find appreciably more elk and deer in the
same area. For example, the draft EIS on page II-36 states that 2,041 elk
were spotted in the elk winter range during a January 1982 aerial survey. In
comparison, in January of 1985 1,500 to 2,000 elk crossed Deckard Flats in 1
or 2 days. The way this winter is starting, I predict that in January of 1986
we will see even more elk and deer in the immediate study area. Also, the
draft EIS states on page III-30 that big game animals were not sighted on
developed land within the project area. In contrast to this statement, there
have been several confirmed grizzly bear sightings on developed lands over the
past 2 or 3 years, and, in fact, there has even been a calf moose napping
outside a house in Jardine for the last couple of days. The point is, in
order to properly discuss impacts and possible mitigations, you need to have
accurate baseline information. We feel that the 1982 study doesn't accurately
reflect the wildlife situation in the project area. Does the State or the
C Forest Service feel that 1982 was a representative year? Page III-31 of the
EIS discusses possibly wildlife poisoning from the tailings dump or seepage
collection pond. This is also a concern of ours, and we would suggest that
any area containing toxic materials be fenced to prevent wildlife poisoning
even before it becomes a possibility. Will the State require Jardine Joint
Venture to do this?

D In closing, the application and DEIS note that population influx, increased road traffic, noise, logging, and most of all mining will have a negative impact on wildlife habitat and elk migration. These negative impacts and the DEIS discussion of them which uses vague and ambiguous terms such as: expected, unexpected, unlikely, unknown, probably, probably not, and many others, lead us to conclude that a lot more information on wildlife in the project area needs to be obtained prior to a permit approval.

A Comment noted, thank you.

B We recognize that the number of animals in the study area fluctuates over the years. However, ranges and habitat-use patterns remain relatively constant. The EIS, therefore, contains appropriate impact analyses. Please see letter 32, response FF.

We realize that big-game animals may be sighted on developed land. In addition to your observations, the EIS notes that grizzly bears occasionally use residential areas (see Chapter II--Threatened and Endangered Species). However, we do not consider developed land to be essential wildlife habitat. Despite spending an entire year on the study area, the consulting biologist did not report observing deer or elk on developed land (Westech, 1984).

C Please see the mitigating measure in Chapter I and letter 20, response JJ.

D The EIS does not contain predictions of substantial impacts due to habitat loss or migration barriers. Discussions that appear to be vague are due to the inherent difficulty of predicting the future. Wildlife baseline information is sufficient for impact analyses.

TESTIMONY 2

SUE JOHNSON:

A For the record, my name is Sue Johnson. My husband and I live and run our family business just above Jardine. I'm testifying on behalf of Bear Creek Council, a non-profit citizen's organization concerned with the impacts associated with the Jardine Joint Venture. We are not testifying today in opposition to the Jardine Joint Venture. We are, however, asking that certain steps or mitigation measures be adopted or agreed to prior to the issuance of a permit by the Montana Department of State Lands or the U.S. Forest Service. We will be submitting written testimony that goes into great detail concerning those measures which we feel should be included in any mining permit issued. At this time, however, I'd just like to summarize some of our main concerns. In general, we object to the whole idea of a conceptual permit. We feel that if the partners in the Jardine Joint Venture want to develop a gold mine in Jardine they should at least know what they want to do before going through this impact statement hearing process. For example, has the final mill and processing design been established? No. Has the state water quality discharge permit been applied for and received? No. Has the company and the county conducted an engineering study that weighs the pros and cons of all the road alternatives? No. Has the preliminary utility corridor been established? No. While we are assured by the state and the Joint Venture that the company will not be allowed to begin construction until all stipulations are complied with, will we, the affected public, have the opportunity to review and comment after all of these questions have been addressed?

I would now like to mention some of our specific concerns.

B Water. We are concerned with the amount of water claimed by the Jardine Joint Venture. We would like to know why they have claimed more water than usually ever flows down Bear Creek. Will the partners be willing to guarantee a minimum flow to protect the fishery and domestic and agricultural water supply?

C One of our major concerns is the location of the proposed septic drainfield. The EIS concludes that there will only be a slight increase in nitrogen levels caused by the septic system. Will human waste be the only product introduced into the system. Where will waters go that are used to flush down the mill? What constituents could be introduced besides human waste? We strongly urge the DSL to require that any residual water from the mill, wash room, or any other facility that may contain toxic or hazardous waste material be sent to the tailings pond as opposed to the septic drainfield. Will the company and the state commit to this?

D Roads. We urge the adoption of the newly proposed road into the town of Jardine. As to access from route 89, we cannot favor one alternative over another at this time. We do not feel that an adequate comparative analysis, as required by law, has been done in either this EIS process or in the already-approved socioeconomic impact plan. We feel this analysis should be done prior to permit approval. Will it be?

E Utilities. If the Jardine Joint Venture is serious about beginning construction in 1986, you would think that they would have included the discussion of what kind of utility facilities and where they would be located as part of this EIS.

A Detailed feasibility analyses are not necessary because the Jardine Road is the superior alternative due to the traffic mitigation plan proposed by the JJV and the road improvements agreed to in the hard-rock mine impact mitigation plan. Constructing an alternative access road would not eliminate mine traffic on the Jardine Road and would preclude the planned improvements to the road, thereby compounding public safety hazard on the road. Therefore, the superior alternative is use of the Jardine Road with the JJV traffic-reduction plan and road improvements. See also letter 16, response B.

The JJV may find, during actual production, that changes in the mill facilities or the milling reagents are required to reach optimum recovery. Major changes in mill design or reagents would have to be cleared with the Department of State Lands and the permit application amended. However, the mill and processing systems the JJV proposes to use--first a bulk-flotation circuit, then a cyanide-leach circuit--are standard practices in the mining industry. Major deviations from the JJV's proposal are unlikely. For example, in the flotation circuit, several different brands of frothers are on the market, but the general compositions are very similar. All frothers in use are organic heteropolar compounds such as polypropylene gycolmethylether (Dow Chemical Company, 1976, p. 9). A number of milling reagents could be used, but they all would have the same general properties as those the JJV proposes to use. The environmental concerns would also be about the same (see Appendix 7 for discussion of milling reagents and toxicities). We are satisfied that the JJV's conceptual mill and tailings disposal system would work efficiently and without undue risk to the environment.

The pros and cons of the road alternatives were presented in the draft EIS and updated in the final. Preliminary power line corridors from the Gardiner substation to the mine are identified and discussed in Chapter 1 of this EIS.

The state water quality discharge permit application was received by the Montana Department of Health and Environmental Sciences in November, 1985. This application has been reproduced as Appendix 20.

B Please refer to the responses to letter 10, comment G; letter 13, comment O; letter 17, comment B; letter 20, comment B; letter 20, comment U; letter 20, comment V; and letter 25, comment D, as well as Appendix 17 for a discussion of water supply and water rights.

C All wastes from the lab, the change rooms, and the mill would be routed to the mill system, which is separate from the septic drainfield system.

TESTIMONY 2

D Detailed analyses of road alternatives are unnecessary. The Jardine Road, after improvement and with a mine-traffic reduction plan, is the superior alternative because it provides the greatest benefits in reducing public safety hazard, the major impact of mine traffic. (Please see letter 16, response B.) If all alternatives provided nearly equal benefits, or offered superior benefits to using the Jardine Road with mitigations, then more detailed engineering, geological, and biological studies would be needed. Even if all other routes were feasible and had no impacts to wildlife or aesthetics, the Jardine Road is still superior because of improvements and reduced mine traffic due to the JJV traffic-mitigation plan.

E See Chapters 1 and 4 for a discussion of the power line corridor and responses to letter 32, comments B and RR.

TESTIMONY 2

F Employment. It is assumed that the company will begin operations in the spring of 1986. Is this still the projected time frame? Our concern over the accuracy of the percentage of people hired locally. While the Joint Venture partners have committed to hiring and training a local workforce, have they initiated any discussions with any of the proposed workforce? Have they contacted any of the laid off BN workers in Livingston? This is a crucial concern because if the percentage or location of the workforce is different than assumed, most of the socioeconomic analysis would be invalid.

G Wildlife. Throughout the application and DEIS, cursory or brief exams are given to cumulative impacts on wildlife. Our concern is that these impacts were only analyzed for the proposed project area. The problem is that wildlife does not pay attention to the project area as defined by environmental analysis. The Stillwater project EIS concludes; no significant impacts on wildlife because they can go elsewhere. The Custer and Gallatin Forest Service plans seem to conclude that there will be no significant impacts on wildlife because they can go elsewhere. And now, the Jardine Joint Venture DEIS concludes that there will be no significant impacts because the wildlife can go elsewhere. How long before the elsewhere becomes nowhere?

H In closing, mining has come and gone in the Bear Creek valley since the time of Joe Brown in the late 1800s to the present. While mining has always had an erratic history in this area, a stable, small business climate centered around fishing, hunting, recreation, boating, and tourism has been a constant. We are not opposed to properly regulated economic development in this area as long as it is not at the expense of existing small business or our high quality of life.

F The JJV has not indicated a change in the project schedule. Please see letter 32, response C.

G Please see letter 26, response A for a complete discussion of methods used to address cumulative impacts. Cumulative impact analyses were not limited to the project area. These analyses were conducted throughout three assessment areas (see figures II-11, II-13 and II-16 in the EIS). The Stillwater EIS and forest plans contain analyses more complete than indicated by your comment. Impacts to wildlife are summarized in the EIS. Surrounding habitats and the mobility of wildlife could not be ignored during impact analysis.

H Comment noted, thank you.

TESTIMONY 3

LINDA COLLINS:

I am Linda Collins and my family and I have lived here for over 3 generations. I am here to ask a few brief questions regarding the Jardine Joint Venture and the draft EIS.

A Throughout the application and the EIS, references are made to various chemicals and reagents to be used throughout the milling and processing, and Appendix 7 of the EIS briefly discusses the five different reagents used in the ore beneficiation process. One of these is sodium cyanide. Doesn't it seem contradictory to note, and I quote from the EIS, that "further research needs to be completed regarding the fate and toxicity of cyanide in the environment," and yet the EIS concludes that there will no significant impact to air and water quality, wildlife, or the Bear Creek watershed?

B Furthermore, I could not find any listing of any other chemicals or toxic substances or their impacts on the environment anywhere in the EIS. Will the final EIS contain a listing of these substances, the amounts present, and their potential impacts?

C Next, while I appreciate the proposals to mitigate seepage and spillage from the tailings area, I am concerned with the discussion given faulting and earthquakes as they would apply to these structures. For example, the EIS concludes that an earthquake of around 7.3 on the Richter Scale could cause considerable damage. It then indicates that this is not a concern because "such a large event would probably occur about once every 10,000 years." When discussing major events over time, agencies have a tendency to assume that we are at year one as opposed to year 9,998. When was the last quake of that magnitude in this area? Further, the EIS concludes that the Bear Creek fault is probably inactive. On what analysis was this conclusion based? And finally, it seems that construction standards for all mine-related buildings and associated mining facilities are not included in the application or the EIS. First, I feel they should be included and second, will these buildings and associated mining facilities be constructed to accepted earthquake standards?

D In conclusion, like many of the Bear Creek Council members who are testifying tonight, I am not testifying in opposition to this proposal. However, I do believe that there are many questions that the state and Forest Service are required by law to answer prior to permit approval. So it was with great dismay that I read Mr. Walther's statement in the Livingston Enterprise that a final EIS may not even be prepared. Mr. Walther, the concerns you have hearing tonight most certainly raise new issues that are significant, and that need to be responded to in a final EIS.

A The effects of the tailings on wildlife are discussed in Chapter III--Wildlife. In response to the unknowns identified in the discussion, the applicant has proposed to monitor the tailings area and fence the seepage-collection pond. A fence around the return-water pond would be required.

The fact that further research needs to be completed regarding the fate and toxicity of cyanide complexes and reaction products does not necessarily prove there is currently a problem with the use of cyanide. For example, the 1983 National Science Foundation report also indicates that there were "no areas identified where the proper use and handling of cyanide in current (mining) operations has had an adverse environmental impact."

With regard to the JJV project, no water quality impacts were predicted as a result of the use of sodium cyanide for the following reasons:

1. state-of-the-art design of the tailings impoundment;
2. deposition of a dry, dewatered tailings material;
3. proper use and handling of sodium cyanide reagent;
4. state-of-the-art design for all seepage and return water ponds.

B A list of ore processing reagents and their rates of application appear in Table III-33 in the EIS. The quality of the effluent from the mill processing circuit is presented in table III-4 in the EIS. There would be no discharge of tailings effluent; the process water would be recycled to the mill. State-of-the-art design for the impoundment and all ponds insure the integrity of the operation. Also, please see letter 32, response EE, and Appendix 22.

C The 1959 earthquake at Hebgen Lake measured 7.1 on the Richter magnitude scale and was the largest ever recorded in the Rocky Mountains. It caused noticeable ground shaking at Jardine, but did not result in any serious structure damage. The intensity of ground shaking at Jardine was estimated to be VI on the Modified Mercalli Scale (see Appendix 6, Table App. 6-2). Although the Gardiner/Yellowstone area is a region of higher-than-average earthquake activity, it is still less dangerous than other regions of the world, such as California, Alaska, and Japan. The JJV would be required to construct the mill using design specifications that would withstand strong ground shaking (see Chapter III--Geology, Mitigating Measures). Alarm systems, automatic emergency shut-off valves and ditches beneath tailings slurry and return-water lines would adequately protect the ground and surface water quality of Bear Creek (see Chapter I).

The Bear Creek fault is believed to be inactive because 1) it lacks fresh fault scarps along its trace, 2) no earthquake activity has been recorded in the immediate vicinity of Jardine, and 3) it does not follow the general pattern of active faults in the Gardiner/Yellowstone region.

D Comment noted, thank you.

TESTIMONY 4

MIRIAM SKERTICH:

A My name is Miriam Skertich. I am a member of the Bear Creek Council. I work in Livingston, Montana and I live in Jardine and I also have a daughter in the Gardiner elementary school. My family and I will be directly impacted by the Jardine Joint Venture.

I would like to make a few brief comments and suggestions on the draft EIS and the Jardine Joint Venture application. Our domestic water supply and that of others that live in Jardine is dependent on Bear Creek both in quantity and quality. The draft EIS states that the septic drainfield will "be about 100 feet from Bear Creek." While the sanitation laws allow the location of septic drainfields just with a 100-foot buffer from surface waters, we urge the County Commissioners and the sanitarian to have the Jardine Joint Venture move this septic field further away from Bear Creek. Were other locations studied? If so, why was this the preferred location? While the draft EIS noted an increase in nitrogen in Bear Creek coming from this septic field, it doesn't discuss any of the other impacts from the drainfield. We would like to know what other substances would be introduced to the drainfield? For example, where will the waste waters from the shower room or milling facility be drained to? Our concern is that there may be other potentially toxic materials placed in the septic drainfield. In order to avoid a potential hazardous health or biological problem, we suggest that all nonhuman waste materials be entered into the tailings dump cycle. Would the state be willing to require this and will the Jardine Joint Venture commit to this? The draft EIS notes that testing will be done on fecal coliform bacteria and nitrogen below the drainfield. Would the state be willing to require testing for other materials that may be introduced in the surface and ground water of Bear Creek by the drainfield?

B We would appreciate your clarifying where water will be withdrawn for the project. On page I-7 of the draft EIS it is stated that water will come from either Bear Creek, Pine Creek, or a ground water well. However, on page III-5 it states that all the project's waters will be withdrawn from Bear Creek. We would like to know more specifically at what point and in what quantities will water be drawn and if any domestic or agricultural water losses occur due to this project, will Jardine Joint Venture commit to replacing the water withdrawn?

C As we live in Jardine, we are also concerned with the mitigation measures such as increased insulation that will be taken to reduce or minimize noise. Would the Jardine Joint Venture be willing to use whatever means necessary to maintain existing baseline noise levels?

D We were told by the Jardine Joint Venture officials that the crusher would only be present a few weeks. I know it wasn't running today, but it is still there. How long is this going to be operating?

E Finally, we would like to note our concurrence with the agencies' recommendation for the mine access alternative 1 that leaves the historic district intact and bypasses the town. Is there any reason that the Jardine Joint Venture would not go along with this proposal?

A Please refer to letter 6, response D and testimony 2, response C.

B Please refer to letter 32, responses P and R, as well as Appendix 23. Montana's Prior Appropriation Doctrine would not allow downstream domestic and agricultural senior water users to be affected by upstream junior water rights holders.

C Please see letter 32, response N.

D According to Mike McLean of the JJV project, the crusher was shut down on March 4, 1986. However, it may be used intermittently in the spring, and would be kept on a standby basis, as allowed under the JJV's exploration permit (pers. comm., March 10, 1986).

E Please see response to letter 3, comment A and Chapter 1--Alternatives which discuss the mine access road alternatives.

TESTIMONY 5

JIM MARTY:

A My name is Jim Marty. My wife Joan and I live in Jardine and are members
of the Bear Creek Council. We live almost directly across from the proposed
tailings dump. Our first concern deals with the accuracy of the statements
made in the Air Quality Permit Application (AQPA) and the draft environmental
impact statement concerning wind velocity, frequency, and direction. Figures
show low levels of total suspended particulates and only for short periods.
This is inaccurate because the monitoring stations gathered data for only a
few hours each month. Residents of this area have seen the tailings blow for
extended periods to the extent that downwind visibility approaches zero. This
condition exists with tailings picked up from the flat impoundment. How much
worse will it be when the pile reaches its proposed height of 125 feet? To
B remedy the situation, the draft EIS suggests that the Jardine Joint Venture
could install a hood on the conveyor, they could use a chemical dust
suppressant, or they could limit the fall distance of the tailings. We urge
that they be required to do all of these things. Would the Jardine Joint
C Venture be willing to commit to this? Controlling blowing tailings not only
reduces the human health hazard, but also serves to protect revegetated areas
where fragile new plant growth could be inhibited by tailings deposition. The
air quality permit application states that if the concentrations of arsenic,
cadmium, or chromium reach a certain level, or if new pollutants are intro-
duced, or if visibility is reduced, additional monitoring could be required.
This is too discretionary. We would request that if these conditions develop
additional monitoring be required immediately. A plan should also be made to
remedy any of these conditions before they exist. Is the Jardine Joint
Venture willing to commit to this?

D Referring to the charts on pages III-44 and III-47 of the draft EIS, it
is noted that chemical stabilization can provide as much as an 85 percent
reduction in uncontrolled emissions while watering provides only a 50 percent
reduction. The Jardine Joint Venture proposes to use chemical stabilization
during the mining stage but water only during the construction stage. If they
are committed to using the best available control technology, why can't they
use chemical dust suppression during the construction stage also? In addi-
E tion, could the Joint Venture commit to using a chemical dust suppressant on
the Jardine Road since the air quality permit application states this will be
a major dust source? Would they commit to using a terraced tailings impound-
F ment dam as they have done elsewhere to control erosion and maximize soil
stability?

G We feel there is also a need for a more detailed contingency reclamation plan in case the Jardine Joint Venture closes for any reason. We are concerned that if such a plan is not prepared and the mine closes, even temporarily, that a health hazard could exist while a reclamation plan is developed, approved, and financed. Is the Jardine Joint Venture willing to prepare such a plan?

A See response to letter 32, comments MM and NN. With respect to the height of the tailings pile, an important consideration is saltation. Saltation refers to the process of wind erosion where particles which have been dislodged from the surface by the force of the wind, roll or bump along the downwind surface causing more particles to be dislodged, adding to the total airborne particles. The effect of saltation would be less on a sloped surface than on a flat surface and is proportional to the size of the exposed surface. Concurrent reclamation would minimize the exposed area.

B A number of possible mitigative measures are noted for various emission sources. In some cases, it is not possible to determine beforehand whether mitigation would be necessary. Rather than require an unnecessary mitigation, it was determined that evaluation of some sources while in operation would allow for the best decision on the necessity for mitigation. The discussion of possible mitigations is included to verify that acceptable mitigations are available, if necessary. The Air Quality Bureau of the Department of Health and Environmental Sciences (DHES) would make these decisions based on site inspections, air monitoring results, and public comment.

C The Air Quality Bureau (DHES) has developed the required ambient air monitoring program, taking into account the mining plan, metallurgical processes, chemical characteristics of the material, and knowledge of similar operations. The program is designed to have flexibility to acquire the necessary information.

D See letter 32, comment PP.

E The air quality permit now requires chemical stabilization of the access road through Gardiner and Jardine. The need for stabilization on other portions of the road or the entire road would be determined by the Air Quality Bureau. This change has been made in Chapter III.

F The applicant's reclamation plan would be sufficient to control erosion and maximize soil stability.

G DSL feels that the applicant's reclamation plan, as presented in its permit application is sufficient for this project.

TESTIMONY 6

BOB GRESSWELL:

My name is Bob Greswell. My wife and I reside along the county road to Jardine approximately 1/4 mile east of its junction with highway 89. We will be directly impacted by the proposed Jardine Joint Venture project. Although we support economic stability in the Gardiner community and increased economic stability for Park County which this project may bring, we have serious doubts concerning three issues and the manner in which these issues are dealt with in the draft EIS.

A The first and foremost of these concerns is the proposed access to the Joint Venture project from highway 89. In the Jardine Joint Venture Hard-Rock Mitigation Plan, the proposed plan of action was to consider both 1) upgrading and rehabilitating the Jardine Road and 2) constructing a new road using existing and right-of-ways pending the completion of an engineering analysis. In the Joint Venture Operating Permit Application, it was stated that "final plans will be developed for the new construction after permit approval and prior to the beginning of construction." In the EIS, however, the application proposed "to use the existing Jardine Road as access from Gardiner." Why does the proposed route differ in the EIS? Have engineering studies been completed? If so, why haven't the results of these studies been included in the EIS? If studies have not been completed, when will they be completed? Why has the access road, a potentially controversial issue, been allowed separate approval and not been viewed as an integral part of the operation application? In the mitigation plan, preliminary cost estimates suggest the cost of between $750,000 and $1 million plus land acquisition and relocation costs for a new road and that road rehabilitation would be somewhat less expensive. Whatever option is chosen, the Joint Venture states they are willing to directly "procure and manage the reconstruction process." In the EIS, the applicant has agreed to pay $500,000 to the Park County Commissioners to upgrade the Jardine Road. Again, there has been an apparent decision made concerning the access route. Does this mean the mine will no longer support costs above $500,000? What improvements are to be made under this option? How much land will be required? Which landowners will be affected? Will the grade of the road be reduced? Will there be any portions paved? Will sidewalks and gutters be provided through the residential section along the lower portion of the road? Is the $500,000 actually a simple prepayment of taxes as stated in the mitigation plan? Why aren't these cost estimates included in the application? Although the EIS does mention public safety as a disadvantage to the use of the existing county road, neither the mitigation plan nor the operation application mention this factor. Should visual impact be considered in the decision? Would an alternative route, such as alternative A in the EIS, alleviate safety problems to people in the residental areas? Much of the remaining land for residential development in the Gardiner area lies along the lower portion of this county road. Will a substantial increase in the number of residences in this area be considered in the final access decision?

B A second concern we have is the location of the required 69-kilovolt transmission line to be supplied by the Montana Power Company to the Joint Venture project. When will the exact location of this line be made public? Why wasn't this included in the EIS? Since this transmission line may also be an important impact, albeit indirect, of the proposed project, should it be
C part of the operational application? Does the Montana Department of State Lands have the authority to require that both the road and the power line issues be addressed in the permit application?

A The permit application contained the draft hard-rock mine impact mitigation plan submitted to Park County by the JJV. The final plan negotiated by the county and the JJV agreed that the Jardine Road would be improved and used as the mine access alternative. The JJV would submit a permit amendment identifying the elements that changed from the initial draft to the final approved impact plan.

Engineering, biological, and geological analyses were not necessary to compare the benefits of road alternatives. See letter 16, response B and testimony 2, responses A and D.

The access road was not allowed separate approval. The EIS has compared alternative access roads and selected the Jardine Road with traffic reduction measures and the planned improvements as the preferred alternative (see Chapters I and IV). Other access routes do not reduce public safety hazards because mine traffic could still use the Jardine Road, which would not be improved.

The JJV would provide $500,000 in tax prepayments to upgrade the road. Additional funding would be at the discretion of the county commissioners and would be funded by future tax receipts. Road improvements would include: grade reduction, sight visibility improvement, installation of guard rails, and drainage control.

B See letter 32, response RR. The final EIS evaluates alternative power line corridors (see Chapters I and IV). In addition, a public meeting was held on March 11, 1986, in Gardiner to discuss the power line alternatives.

C The Metal Mine Reclamation Act requires the applicant to provide in its application a map of the mine area and to locate proposed roads, railroads, and utility lines in the immediate area.

TESTIMONY 6

D Finally, according to the EIS, the project will require .073 cfs of surface water for operation. Since summer flows rarely exceed 20 cfs, there is a decided potential to totally dewater Bear Creek if their priority dates pass the adjudication process. Since the claimed water is 6,000 times as much water as needed to satisfy the requirements of the proposed project, what can water users with a lower-priority claim expect when the mine begins operation? It is my sincere hope that these concerns can and will be addressed prior to the Joint Venture permit approval. I believe that if these issues can be settled before operation begins, community support of the mining project will increase greatly. It would also appear that detrimental impacts on the community of Gardiner would be reduced and benefits beyond those of monetary well being would be available to a greater portion of the area's residents.

D Please refer to the response to letter 10, comment G; letter 13, comment O; letter 17, comment B; letter 20, comment B; letter 20, comment U; letter 20, comment V; and letter 25, comment D, as well as Appendix 17 for a discussion of water supply and water rights.

TESTIMONY 7

RICHARD PARKS:

For the record I am Richard Parks. I run the Parks' Fly Shop here in Gardiner and am a member of the Bear Creek Council. I am also president of the Fishing and Floating Outfitters Association of Montana, which represents 120 outfitters statewide and it is on their behalf that I am here tonight. We have an overriding interest in water, both in terms of quality and quantity, and my testimony will be directed to that aspect of the plan. I will deal first with the questions of quality, then quantity.

A In general, I am not much worried about small leakages from the system. I am satisfied that the monitoring plan presented will detect such problems in time to take corrective action before major damage is done in most cases. However, the plan calls for a major amount of the tailings, impregnated with arsenic and processing chemicals including cyanide, to be returned to the mine as backfill. The plan explains how this material will be handled in the mine. Can it be dewatered as are the surface tails? If not, where does the drainage water go? It has been proposed that it go into a mine sump where it is returned to the mine-mill water cycle. Nowhere that I can find in the plan is there an explanation of what steps will be taken to insure that this contaminated material does not reach the ground water or surface water system. What specific means will be used to detect contamination from this source which is outside the area the monitoring system specified? What specific means will be used to segregate this material from the ground water system? Assuming for the moment that the answer is that there is no problem because of the nature of the rock formation; what exactly is that nature and what assurance do we have that it is uniformly effective as a barrier? If we assume that faults and other fracture zones exist that would allow the movement of mine water into the ground water, what specific means will be used to detect and prevent it? We believe that approval of this plan should be conditional on the development of satisfactory answers to these questions. Will that be the case?

B I am pleased with the completeness of the plans for the tailings site itself and am satisfied with that aspect of the plan. I compliment the Joint Venture for their work here and their plan to clean up the tails left by the old operation. I consider that a major plus for the plan. Unfortunately, there are two additional holes in the tailings plan. The plan does not specify that the ditch in which the slurry line runs will be lined. Frankly, I am very worried about the catastrophic type failure to the system that results in a major spill. In fact, the EIS admits the high probability of a major seismic event in the area during the mine life. The resulting damage to the mine operation in that event has the potential to be a major health hazard as well as hugely destructive of the businesses that I represent. Will the plan approved be conditional upon development and implementation of a plan to line the tailings ditch with an impermeable layer to protect against a pipe rupture? We believe that it should and must be so conditioned.

The next problem has to do with the means used to transport the backfill tails to the mine. I have already discussed my problems with the way they are handled in the mine, but I am really concerned with this aspect of the problem. There is no description that I can find of the details of this. We are assured that they will be moved in a pipe similar to that used to transport the tails to the disposal site. How will this pipe be protected

A The applicant has determined that dewatering the tailings material before backfilling would be impractical and cost prohibitive. However, additional commitments to prevent environmental contamination from the mine have been made. These commitments include: 1) All tailings from the more toxic, cyanide-agitation circuit would report to the lined impoundment, 2) all ditches and sumps in the mine would be lined, 3) grouting would be performed in the mine to stop the flow of water, and 4) the last two feet of sand backfill would be mixed with cement to create a hard impermeable surface.

Only bulk flotation tailings would be backfilled into the mine. These tailings would contain a relatively low concentration of heavy metals (see Appendix 1). Arsenic is the major constituent in the bulk flotation tailings water that could pose a hazard to offsite water quality and even this metal would be rendered harmless if backfilled into the mine. First of all the applicant has agreed to institute several measures that would reduce the amount of water lost to bedrock fracture systems (see Chapter I). Even if considerable backfill water were lost to fracture, it probably would not degrade offsite water quality. Arsenic concentration in water reaching Bear Creek would be much lower than the original backfill water levels because arsenic is readily absorbed into native materials. This assessment is based on leaking tests the JJV undertook which showed most of the arsenic is removed from tailings water upon passing through soils, and water quality samples at other operating mines in Montana confirm the low mobility of arsenic.

B See letter 19, response K which discusses the slurry/return pipeline system. The JJV has committed to several design criteria for the tailings slurry and return water pipelines (see Chapter I).

A major spill could not occur because the emergency shut-off system would limit the volume of liquid of the broken pipeline. The details of design features which would provide environmental protection are presented in Appendix 24.

TESTIMONY 7

against rupture? Assuming that a rupture takes place, what means will be used to isolate the spill from the ground and surface water systems? A mere detection and shut down system appears to be inadequate. Will the plan approved be conditional upon development and implementation of a system to contain such a failure? We believe that it should and must be so conditioned.

C When I read the mine plan and the resulting EIS draft it seems to me that people are working on the assumption that systems will work the way they are intended to work without fail. Our position is that this is not good enough. We cannot tolerate a system that is "zero discharge" only when it works. We need every assurance that we can get that no matter what happens the physical and chemical integrity of the system will be maintained. The draft before us points out the biological significance of Bear Creek so I do not need to elaborate on that point. What the draft does is raise some of these issues of catastrophic failure of then dismiss them on the basis of statistical unlikeliness. We do not believe that these issues are the straw men that they have been made out to be. In our view, the eventual approved operating plan must deal at every step with the assumption that the primary system proposed to deal with a potential problem will fail and plan for backups. There is no backup in the tailings pipeline. There is no suggestion that there even needs to be a primary failsafe for the mine return slurry line. The potential problem in the mine is dismissed as if it didn't exist. We believe any approved plan must deal with these shortcomings. Since the plan presented so far is merely conceptual as far as the actual layout of the mill area, all we can do is ask will the plan require redundant failsafes to provide for the integrity of the mill site from contamination? What specifically will these be? The very nebulosity of the plan gives us great concern.

C Please refer to Appendix 24 for details and commitments by JJV in the design of the backfill and return slurry lines.

D Turning now to the question of the wastes discharged to the drainfield we find another area for concern. We are aware that the plan complies with the law. We have a concern, though, that is based on our understanding of human nature on the one hand and those unknowns in the mill operation on the other. A drainfield works fine as long as it isn't overloaded and as long as the materials discharged into it are essentially domestic waste water. Unfortunately, there will be materials in the mill that are not in this category. What assurance do we have that toxic materials will not be discharged into the drainfield? If such a discharge is allowed, what are the specific tolerable limits of exactly what materials and how will this be monitored? In short, just what will be specified by the permit in terms of toxic waste management? We believe that the approved plan must be conditional upon the establishment of such an acceptable plan.

D Please refer to testimony 2, response C.

E Turning now to the issue of water quantity, we find the mitigating measures proposed strangely silent in view of the water rights filings. The draft EIS itself says that during low-flow periods the water withdrawal could potentially have adverse impacts on Bear Creek. It is interesting that claims have been filed on 6,000 times the estimated water requirement. We know that the Joint Venture has filed for its historical rights as they were encouraged to do by the Water Court. This is not the forum to fight that issue, but in view of that, it is important that the plan approved contain some mitigating measures to protect low flows. Discussions with the company indicate that the estimated requirement of .073 cfs is exclusive of any requirement for fire suppression. On the other hand, about half of the requirement is for dust suppression and a mitigating measure is suggested for that. Will that mitigation be required? The source for the water is also a bit unclear as I

E Please refer to testimony 4, response B.

TESTIMONY 7

don't find "Bear Creek, or Pine Creek or maybe a well" a very clear proposal. In view of the above, we have a suggestion that so far does not seem to be included in the plan anywhere. I assume that the water supply will be processed in some way before it is introduced to the mine operation. We recommend that the processing system include a storage tank sufficient to provide for fire protection that can be filled during high-flow periods. A high-capacity storage tank would be an advantage during adverse weather and could easily help compensate for unusual climatic conditions that reduce the availability of water. Can and will such a provision be required as an additional mitigating measure?

In summary, we find several mitigating measures suggested as possible in the draft EIS. We have some detailed concerns outlined above. We urge your consideration of these issues. Specifically, we recommend and ask that the mitigating measures be made conditions of approval of the mine operating plan.

TESTIMONY 8

JOYCE LUDWIG:

Hi. I'm Joyce Ludwig. My husband Charles, and daughter Jennifer and I live in Gardiner at the base of the Z-Hill, Lot 1, Parkview Estates. First of all, I would like to say I support the Joint Venture. The mine will add economy and employment to southern Park County. My concerns deal with the existing Jardine Road being the mine-access road. The road cannot be improved to a degree where it will eliminate hazards. Our area is too confining and too congested to handle the increased traffic resulting from the mine development. Over the life of the mine there will be increased accidents, unavoidably so due to increased traffic. As a landowner, I would like the following concerns addressed.

A 1. Have any engineering studies, cost comparisons been done concerning alternative B?

B 2. Applicants state $500,000 will be obligated for road maintenance on the Jardine Road. Past road maintenance practices show present road maintenance has been inadequate. How will this money be spent?

C 3. How will we be assured that the roads will be maintained for the life of the mine or in a better way than at present?

D 4. Will Montana power lines be upgraded?

E 5. Water drainage is a real problem. We have Phelps Creek runoff, spring thaws, and no adequate ditches or culverts to handle excess water. What do we plan here?

F 6. In general reconstruction, will the grade of Jardine Road change?

G 7. If traffic increases, I have concerns over our children. We have an established bus stop. How can we assure their safety on the road?

H 8. Will the Jardine Road be patrolled? Will speed zoning be established or enforced?

I As a landowner, a resident, and a concerned citizen, will I have to change my lifestyle? Will my family?

A No cost comparisons or alternative studies have been done regarding alternative B. See letter 16, responses A and B.

B The $500,000 is for road improvements and not maintenance. See testimony 6, response A.

C Road maintenance is planned and funded by decisions made by the Park County Commissioners. Road maintenance requests, petitions, and suggestions should be presented to them.

D More information regarding the possible power line routes and design changes has been incorporated into Chapters I and IV (Alternatives, Electrical Power Lines).

E The proposed project does not affect Phelps Creek, and the applicant is under no obligation to correct an existing condition.

F Reduction of grade on Z-Hill is one of several steps the applicant may take to improve the county road. A detailed design engineering study would reveal specifics of the improvements, including gradient change. Also, please see testimony 6, response A.

G The JJV has developed a traffic mitigation plan which would reduce mine traffic and would route such traffic over the road at times that would minimize conflict with other users of the Jardine Road (see letter 16, response B). Contact the Park County Commissioners to ask that the road improvement study address adequacy of the existing bus stop and road signs.

H There are no announced changes in patrolling the Jardine Road or in designing the speed zones along the road. The JJV would make recommendations to the county commissioners for posting of speed zones.

I The lifestyle of you and your family should not change much due to the project. The JJV would employ 150 people at peak production and the majority of employees are expected to be local area residents. The effect of the JJV would be much smaller than the population changes due to tourism in Yellowstone Park. The JJV project should help the Park County economy, which could benefit your family.

TESTIMONY 9

CLARENCE JOHNSON:

I'm Clarence Johnson. Number one, I am opposed to Homestake and Jardine Joint Venture totally and I think this meeting is just a joke because I read in the paper that this guy said it was alright and they are not going to do anything about it. I never made a written speech or nothing, but I'd like to address the issue of noise. They say oh yeah, maybe we'll do something about it or insulate something. Well I've lived with it for 10 years now almost and it is bad to the point the inside doors rattle, windows rattle, called up over there and nothing is done. It is not going to do anything but get worse. Number two, we are sitting there in critical grizzly bear habitat. What is the solution in the book? Leave them be. And elk winter range, taking away 140 of them 200 acres of prime winter range that we need and so we are involved in a land trade with our place on Deckard. I don't see any solution to that. I don't see any solutions in this book. I see just questions answered by questions. Thanks.

In response to the December 3, 1985, meeting in Gardiner, Montana, as well as oral and written testimony and numerous letters, the JJV has amended its mine plan to address public concerns and to mitigate potential impacts. Please refer to the Preface of the final EIS. Also note that only 60 acres of elk winter range would be removed by mining. Letter 2, letter 22, and letter 32, comment N, respond to issues concerning wildlife and noise.

TESTIMONY 10

BOB ANDERSON:

My name is Bob Anderson. I am the executive director of the Greater Yellowstone Coalition, which is a conservation group headquartered in Bozeman. The Greater Yellowstone Coalition includes a number of conservation groups, 45 to be exact. You have heard already this evening from 2 of those, Bear Creek Council and the Fishing and Floaters Outfitting Association of Montana. We warmly endorse testimony of our members you've heard this evening. In the spirit of holiday cheer, I'd like to pass on a little good will as I start.

First of all, I think the Joint Venture companies ought to be complimented for their performance so far and for their attitude so far. I think we've seen a significant change in the attitudes of the mining industry over the last 10 or 15 years. I think the industry has realized that the commitment on the part of society to environmental values is deep and long lasting and I think the industry has realized that it is in its own best interest to be good environmental citizens over the long term and I think Homestake has been a leader in the change of that attitude. I think American Nickel and Copper has been responsive as well. I would also like to compliment the agencies who prepared the environmental impact statement. I think it is a reasonably good job. It is one of the best ones I've seen. And, in particular, I want to compliment the agencies for, what I believe, is the first significant attempt to assess the cumulative effects of not just the proposed project, but other projects nearby. That is something that our organization has encouraged for a long time and I think it has been done, at least in a limited way, in this case and we think it is an important and significant first step. Lastly, I also would like to compliment the people who are here tonight. Those who have testified have taken a rational and responsive approach to this whole project because it is important for this community. The mining industry is fond of pointing out that minerals are where they are found. They are not planned. They are put where they are for reasons we don't fully understand, but they are where they are found. The same thing is true for Yellowstone National Park, the greater Yellowstone ecosystem. There is only one like it in the whole world and it is where it is found. The Joint Venture companies had the mixed blessing of finding minerals where they found them in Jardine, but finding them so close to Yellowstone National Park, adjacent to a cutthroat trout spawning stream, and situated among grizzly habitat and adjacent to elk winter range and migration routes, and I believe that puts an extra burden on the agencies and on the companies because this is such a special place, because the people of this country are so deeply committed to the long-term preservation of Yellowstone and its surrounding ecosystem.

A I mentioned the cumulative effects analysis. One of the reasons that the Greater Yellowstone Coalition was formed in the first place was because conservationists in this region and across the country were dismayed by the way decisions were made. We saw that decisions were usually made in a very isolated way. That is, a proposal was made and the agencies and the companies considered the social, economic, and environmental effects of that project and very seldom, if ever, took into account proposals for other projects and other developments very near by. Projects which would have cumulative effects when they happened at the same time. I think the agencies have done reasonably well in making what I think is a first attempt, at cumulative effects analysis

A & B Please see the responses to your letter (letter 26). Response A gives the information necessary to duplicate cumulative impacts analyses. Also note that most moisture would be removed from the tailings. The tailings would then be deposited in a pile or dump. The applicant now proposes to monitor the tailings area and fence the seepage-collection pond. The final EIS lists required mitigating measures. The Greater Yellowstone Coalition should contact the applicant to discuss additional mitigations. Your other comments are noted.

merely by considering that there are some timber sales proposed nearby and that there is increased access proposed in the West Gardiner area. We feel, however, that the cumulative effects analysis should go a little bit further. First of all, we would like to see the environmental impact statement explain the methods used in the cumulative effects analysis. I have a hunch, based on my reading of the document, that it was sort of a seat-of-the-pants approach and, of course, that is better than nothing. As time goes on, we would like to see the agencies develop a much more rigorous approach to doing cumulative effects analysis. An approach that can be duplicated by other researchers and one that is defensible in court. We also think that other projects beyond the Bear Creek drainage ought to be considered in the cumulative effect approach. That is particularly true of the grizzly bear. The grizzly is a very wide-ranging species and a single bear can cover a lot of territory, so a single bear can be affected by proposed development as far away as Ski Yellowstone or even farther, so we think that the cumulative effects analysis ought to consider a wider range of proposed development than this particular analysis did. We are a little bit concerned that the environmental impact statement was somewhat vague about proposed timber sales in the Bear Creek drainage. We've reviewed the Gallatin Forest plan and we see in this environmental impact statement a reference to the withdrawal of a couple of sales in the vicinity of Jardine, but we would like some more information about that and we'd like to know just exactly what is proposed in the way of timber sales by the Gallatin National Forest.

B The environmental impact statement has quite a bit to say about monitoring--what will happen in the area of the tailings pond, in particular. Monitoring, of course, is awfully important because the best intentions and the best analysis cannot accurate predict the future. We can't predict the weather. We can't predict human behavior very well and we can't necessarily anticipate some of things that could happen to the water and water handling systems, in particular the tailings systems in this project. I think the way to really add some teeth to this whole process is to put some feedback in the system so that if the permit is granted, it be granted in a conditional way to say that if the monitoring should show that the system isn't working properly, then there is a requirement that some actions be taken, that those adverse affects be mitigated and, if they aren't, the permit be withdrawn. I think that sort of lever with authority needs to be included in the process. No matter how good a job the companies and the agencies do on the impact analysis and on the operation and monitoring of the mining project, no project can have a zero impact. That is especially important for a sensitive species like the grizzly bear. Perhaps, with elk or with cutthroat trout, especially with elk can tolerate a small impact, but with the grizzly bear that is not the case. The grizzly is a threatened species under the terms of the Endangered Species Act and the official policy of the government of this country to restore the health of that population in the greater Yellowstone area and no matter how good the company does in its project, there will be at least a small adverse affect on the grizzly bears. Now, there are a couple of ways to approach that. You can argue that this project, therefore, should not be allowed. Another approach to argue is that we can't turn back the clock, can't stop progress, and we need jobs in this community. The companies are doing a good job, but we have to do something to offset that small, but negative, effect on the grizzly bears. That brings up the concept of compensation. The companies could either voluntarily or be required to provide some sort of compensation that would improve things for grizzly bears some place else. For example, the State of Montana Legislature in its last session approved a grant to Gallatin

TESTIMONY 10

County to bearproof dumpsters in West Yellowstone. West Yellowstone is virtually the only community in the greater Yellowstone area that is not bearproofed in the community and it is common to see bears roaming through downtown in search of an artificial food source because the dumpsters are not bearproofed. Those bears become habituated to garbage and the usual result of that is the death of the bear. Well, something can be done about that, those dumpsters can be bearproofed. In fact, the Joint Venture could provide the required match to the state grant provided to Gallatin County. Well, you might ask what does West Yellowstone have to do with Jardine. You might argue biologically that some of those same bears that visit West Yellowstone also visit Jardine. The important concept here is compensation. Recognizing that the Jardine project would have an adverse affect on bears and trying to offset that effect by improving the lot of bears in some other part of the ecosystem. I would like to make that a frontal request to the companies to seriously consider and I would like to follow up on that notion with them at a later date at their convenience. The same concept can be applied to elk. For example, the company could secure winter range in the lower valley to offset whatever effect it might have on the wintering and migration of elk near Jardine. And similarly, with cutthroat trout the company could provide stream reclamation or fund research to improve the lot of cutthroat trout spawning in this region to offset whatever adverse effect this project might have on cutthroat trout.

C So, in conclusion, I'd like to say that it is somewhat the misfortune of the company to be located where it is and I think they've done a reasonably good job. I think they have been good environmental citizens and I think their project can be improved by conditioning the permit with a feedback mechanism so that if things don't go as planned there will be some authority in achieving that permit and I also encourage the compensation, especially with the grizzly bear, included either as a permit requirement or as a voluntary measure by the company.

C Comment noted thank you.

TESTIMONY 11

JERRY DANNI:

Actually on behalf of the Jardine Joint Venture we only had a few comments. We won't specific aspects of the EIS or the application. That is really Kit's job and Sherm's job and I don't want to do their work for them tonight. What I do want to do is assure you that we have been listening very attentively tonight, taking copious notes, and we'll make every effort to respond to concerns that are within our means to respond to. We intend to not only be good corporate citizens, but also, of course, to be your neighbors. Not only in Gardiner, but in Jardine as well. We accepted very early on when we first discovered the Jardine project that it would not be a very easy project to develop given its location. Having accepted that, we are determined to make it a model project and put in these safeguards that, hopefully, will protect the environment as well as the lifestyle that you have grown to like here in Gardiner. Beyond that, I hope to get back to most of you that I have noted that have made comments regarding your specific issues. I think the project manager, Mike McClean had a few other comments too.

Your comments are noted, thank you.

TESTIMONY 12

MIKE McCLEAN:

Thank you Jerry. As Jerry said, I am Mike McClean. I am the project manager for the Jardine project. One of the things I always find unfortunate that occurs in a meeting such as this is that we get two opposing points of view coming together and it is like superbowl Sunday. It starts out with a no-win situation. When, in fact, as Jerry says, what we intend to do and what we want to do is be good, responsible, corporate neighbors and it is easy to sit back there in the audience and say okay these fellows come from Helena representing the State, or Bozeman the Forest Service, from Denver the companies, or even San Francisco. They come in, they leave. Well, I would like to assure you that I am not leaving. I am going to be here. I've got a stake in this community. I've got a stake in the project and I've got a stake in the future of the community. That is not to say for myself or yourselves here and now that we are trying to build an organization, a project, which will benefit the community down the road and I hope to envision our children being able to look back if not working directly for the project, say that the project helped them enrich their lives. I maintain, at the office, an open-door policy. That policy extends to you, the general public. Extends to my employees, to anyone and I always welcome questions. I welcome you coming in. Again, I want to be a good neighbor. I want to be your neighbor and I really hope that we don't take that football approach. That we can get together. That you can express your concerns as some of you have expressed those concerns tonight so that those concerns can be addressed, we can address them as a company, we can remain good neighbors and I hope good friends.

Your comments are noted, thank you.

TESTIMONY 13

TREVOR DOLBY:

A I am a guest here in Gardiner. I am impressed, I really am impressed
with the turnout and the amount of participation and concern in this
community. I've been here a number of times and I really didn't know that I
could expect this from you. In the way of introduction, I am a user and
appreciator of the park and the Gallatin National Forest. I have hiked north
of the Yellowstone in the park for a five-day hike there and up at Pine Lake.
That seems to be a favorite of the Lewistown people and I have been up there
as well and I am a Montana resident. I pay my taxes. I don't have a criminal
record and when I backpack I carry out everything I carry in. My name is
Trevor Dolby and my occupation is gold mining. My purpose in coming up here
to this podium, actually there are three of them. I want you to know that I
support the EIS process for finding out what the concerns of the community
are. My second one is that I also support mineral development in the northern
Rockies and quite honestly, my third purpose in coming down tonight is I want
an opportunity to meet some people in the mining industry connected with this
project and maybe make some contacts that would lead to a job. I am here to
be honest. I thought that EIS, the draft, was pretty thorough myself and I
went through the baseline studies and I've read other EISs and it seemed
thorough to me. The impact estimates that they made in answer to the 26
points of concern gathered last year seemed like they were all addressed,
maybe not to your satisfaction, but it seemed like they were covered and the
mine plan did have gaps in it, but being connected with mining and the
intention with any business I know that you don't always stick to your plan.
B You have to have some flexibility. Two questions that did come to my mind as
I read the report were, I could understand why the small timber sales down
toward Gardiner were included in this particular EIS. Maybe I don't
understand the process thoroughly enough. A second one, I thought it might be
C helpful if there was a counting...there were 62 acres mentioned as being
subtracted from the grizzly bear habitat and, as I've read the report and
looked at the map, it looked like those 62 acres were on the hillside
overlooking Jardine and I wondered whether there are many town residents of
Jardine sighting bears up on the hillside there. I understand that those
bears move around, but there are old mine workings up there as well. It just
seems a curious point to me.

D I've been to Jardine and I like the idea of developing another access road. We have one woman that lives right on the street there and there will be a lot of traffic through there and I think that should be looked at more carefully.

Other specific technical questions and I'll give them to you in writing. My purpose wasn't to come up here to debate point by point, but mostly to speak to you, the people of Gardiner and Jardine. I think the EIS process is working because concerns of you, the residents, are getting written down on these note pads up here and you see the people representing the project taking an interest and taking note in them as well. I'm also pleased that I didn't hear a lot of ranting and raving about the people that would be coming to this town. I've sat in on other draft meetings like this before where there was a lot of hostility about the effects. And there were a lot of pages devoted to the socioeconomic impacts. It is the best title for it and I appreciate that concern.

A Please refer to letter 32, response EE.

B Please see letter 20, response A and letter 26, response A.

C Mining would remove 67 acres of grizzly habitat. Tailings facilities would account for about 60 of these acres. The facilities would be located on a bench south of Jardine. Sightings of grizzlies by local residents are not necessarily reported to the permitting agencies. Old mine workings do not displace grizzlies.

D Comment noted thank you.

TESTIMONY 13

E I, myself, like small towns and whether or not it is going to be 50% or 80% of the new jobs being filled by local people, that is something that has to be questioned and one other specific that I appreciated was those two people concerned about that drainfield. Myself having worked as a gold house recovery technician, I can imagine better than you what gets dumped in those domestic drains. In my lab we had muradic acid, caustic soda, hydrochloric acid, and mercury. We've got a laboratory suggested as part of the outbuildings going with this and they will have a laboratory and it wasn't clear to me whether that was part of the domestic draining system or not. That is one point I should have saved.

I would encourage you people to read carefully chapter VI which is sort of a summary and I will read just one thing out of there. It seems to make more allowances for me and my type. "Gardiner would, however, continue to be a small town whose natural and social amenities remain intact." I like the flavor of Gardiner and Jardine, I've been through here a number of times, but I don't live here, as I've said. And finally I'd like to leave you with a question to ponder. Would it be so bad to share your roads and your highways, and your shopping areas, and your recreation sites with people, like myself. Thank you for your kind attention.

E Please see letter 32, response EE.

TESTIMONY 14

CARLOS CIERI:

My name is Carlos Cieri and I am from Livingston. I am a County Commissioner of Park County. I kind of would really rather have gotten in on the question-and-answer period, but maybe I can clarify a few things on this road. We went through the study and we think it is a real good book the way it came out and there was three roads put in there and there has been a preliminary study made. It was made in October and one of the points in there was that they should have a road starting at the airport which is three miles down the road and cut across the side of the face of the mountain there and come out at Trail Creek. That is over three miles long and it would put a scar right across the face of the hill which would be visible for miles, even into Yellowstone Park. In addition to that, the upkeep on that road would be twice what we have on Z Hill right now. That particular route has two faults in it and, say you did have an earthquake and a shifting, we would have more problems than we are having on Z Hill. Also, one side of it would be over 20 to 30 feet high, which would create a barrier for wild animals across the whole three-mile strip.

The money that is listed there as $500,000 or $750,000 in the Joint Venture project book, that is prepayment money. What that means is the company would pay us taxes ahead of their construction or as soon as they get the permit to construct. We would get so much money; the first would be for a complete engineering study on that hill which would be approximately $50,000, and then you would take out what it would cost to do the hill, to do the work. The work which would entail, right now, which the preliminary study said that the paving on the lower end, where you start at the hill, the hill itself would be widened. A lot of the curves would be taken out, there would be guardrails put in, corners would be knocked off, and it would be a lot safer place. The hill itself would not be paved. I don't know. The reason for that, if it were paved it would be so slick nobody would make it up there. There are people here, I'm quite sure that know, back in the 40s and 50s when you used to go elk hunting you'd stop down by Jim Bridger and put your chains on. Well, people have kind of gotten used to not putting chains on anymore and they think they should be able to drive right up there. Well, we've started sanding that hill and we've been just actually sanding it for about a year, the county has; now they kind of expect to have it sanded all of the time. Once you get past the top of the hill there, the road would be straightened out more and it would be widened and all the way up to Jardine. It would be an improvement, plus a lot of brush would be taken out; I won't say a lot, the ones on the corners where it obstructs the vision. The road would have dust control on it, not necessarily water, but they have chemicals now that they would put on there. That would cut down on the amount of dust and probably stop all the dust with some of these new chemicals. The alternate route that was coming up off the airport hill Rose Glen the mine had anticipated hauling the ore out. Well, they changed their plans, there would be no ore trucks running up and down the road. There would be supply trucks. Actually, most of your traffic would probably will be when it was being built to haul the lumber and the steel and stuff when they are building the mine and the mill. Right now I think there is more traffic with the elk hunters than there probably be when the mine was there. The last two weeks I think if you would have gone up to Eagle Creek, you could just about walk across the top of those trailers up there, there were so many people hunting. I mean it is good

Your comments are noted, thank you.

hunting and stuff and you can't blame them for going up there. We've got a counter on the hill which was installed today and we are monitoring the amount of cars that are going up there without the hunting season on. Of course, we are going to have the special hunting coming up and we will count those too and we can kind of know what the traffic is.

As far as the people going to work up there, we are talking about 100 or 150 people. Well, that is an extreme. You've got to say about half of those people, because everyone is not going to be going to work at the same time, so your traffic wouldn't be 100 cars going up there or 50 cars going up there all at once, single file. You might have 5 or 6 and if they are carpooling, if you got 4 or 5 people in those cars, it is going to cut down on the amount of traffic going up there. If you've got a safer road, which I think everybody would like to see, just even guardrails on there would improve it right now. I think we have a lot of people complaining when there is nothing to keep you from going over the edge. Well, that road has been there for quite a few years and people just have to get used to driving it.

I have this comment on the grizzly bears. I kind of agree with him, but then the other day I noticed that people were coming in to pay taxes and I didn't see any grizzly bears coming in to pay taxes. The economy is shifting quite a bit in Park County and I think that with a little cooperation on this thing, we can make it work. It is something that you've got to give a little and you've got to take a little. The grizzly bear thing, I love grizzly bears, I tried to hunt them for years, I was never lucky enough to get one, but that was years ago. Right now, I'd like to see them. I think something could be worked out with the grizzly bear. Park County has gone to the trouble to fence in all their garbage cans and things in Cooke City and down here to kind of protect that and I think there are ways that that could be monitored up there. If there is a grizzly bear situation that comes up that it can be handled. There is a lot of little problems there. I hear people talking about the water and this and if it even comes half to what that study says, I think it will be a safe situation.

It is not going to be a Butte, Montana, where they went and punched a hole a mile wide and and mile deep and then packed their stuff up and left. It is just that you don't do things that way anymore and I think it is great that they have come out with this study and it shows you what is going to happen.

TESTIMONY 15

JOHN BAILEY:

I am John Bailey from Livingston, Montana, and Dan Bailey's Fly Shop. You may know, a year ago I was the president of Trout Unlimited when this project I want to speak about got started. At this time, I am no longer, but I am certainly involved in the project and I have a concern with what is happening at Jardine. I certainly am encouraged to see someone coming into the area to add employment and the concerns that they seem to be having, but they have also indicated to me that maybe they aren't looking at all the concerns. One of the concerns I've had and many other people is a great sediment load that has been coming down the Yellowstone River for the last several years and it seems to be getting greater all the time. Trout Unlimited undertook to try to put together a group of people to study this problem of you can't do something unless other people agree with you. We were able to bring together the following group. They have put up a great deal of money. We asked the people of Jardine to join. They did not. The group is the Montana Fish and Game Department, Yellowstone National Park, U.S. Fish and Wildlife Service, U.S. Geological Survey, Park Conservation District, that is the local Park County ranchers, Fishing and Floaters Outfitting Association, Montana Water Quality Bureau, and Trout Unlimited. We had a budget of $31,500 to monitor sediment every day throughout the summer in the Yellowstone. Our main concern has been what we perceive to be coming out of Yellowstone Park. We don't have the data to determine where the point sources are, if they are point sources, what the cause is. We are trying to find out. We asked Homestake; Larry Brown from the Water Quality Bureau had talked to Jerry Danni. He indicated he was interested. I talked to him, he said, "please send me the materials," which I did. That is the last we heard from them. We now look at the EIS. If you check you will find out the impact on the first year is 5,775 tons of sediment to Bear Creek. I talked to USGS today. The Boulder River at Big Timber has 9,000 tons a year. In one year. This is in addition, the first year. What is that going to do to the cutthroat? What is it going to do to the Yellowstone? I don't know. I'm very concerned. The EIS says nothing about it. It just says we are going to get it. We are adding 6,719 tons to the Yellowstone. We don't know when, if it is an average, a partial of 1/365th is not so bad. I doubt it. We all know that in Gardiner when it rains it always rains in inches in the summer. The Gardiner River comes down mud. The Yellowstone is a greater river and it needs its protection. All these other people feel that there is a greater sediment load that needs to be addressed and I certainly hope that you will be good neighbors and that you will address this sediment problem that you are proposing to give us. Thank you.

Please refer to letter 6, response A; letter 20, response W; letter 22, responses D and E,; and Appendix 14.

Chapter X: Appendixes

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Appendix 1

JARDINE PROJECT
Composition of Test Products from Laboratory Extraction Testwork on Composite JDN 123
(Percent of Total)

		Feed	Flotation Tails	Leach Residue from cyanidation of flotation conc.
Copper	Cu	0.03	0.011	0.065
Nickel	Ni	0.02	0.006	0.038
Cobalt	Co	<0.02	<0.005	0.010
Iron	Fe	17.2	13.0	29.0
Arsenic	As	3.44	0.12	11.8
Sulfur	S	4.40	0.19	15.7
Zinc	Zn	<0.02	0.02	0.014
Lead	Pb	0.006	0.004	0.012
Mercury	Hg	<0.01	<0.01	<0.01
Selenium	Se	<0.005		<0.04
Tellurium	Te	<0.005	<0.005	<0.05
Antimony	Sb	<0.005	<0.003	<0.003
Bismuth	Bi	<0.01	<0.001	<0.001
Tungsten	W	0.01		
Tin	Sn		<0.001	<0.001
Boron	B		<0.01	<0.004
Silicate	SiO_2		57.5	26.0
Aluminum Oxide	Al_2O_3		9.92	5.67
Magnesium Oxide	MgO		3.81	1.74
Calcium Oxide	CaO		2.13	1.67
Potassium Oxide	K_2O		2.02	1.12
Sodium Oxide	Na_2O		0.39	0.26
Graphitic Carbon		0.10	0.043	0.26
Carbon Dioxide	CO_2	0.55		
Barium	Ba			0.010
Chromium	Cr		0.05	0.028
Manganese	Mn		0.13	0.070
Titanium	Ti		0.21	0.115
Vanadium	V		0.008	0.005
Molybdenum	Mo		<0.001	0.006
Zirconium	Zr			<0.002
Phosphorus	P			0.03
Lithium	Li			<0.001
Strontium	Sr		0.005	0.007
Beryllium	Be		<0.0003	<0.0003
Germanium	Ge		<0.001	<0.001
Thallium	Tl		<0.003	<0.003
Niobium	Nb		<0.002	<0.002
Cadmium	Cd		<0.003	<0.003

Appendix 2

Distribution of Macroinvertebrate Taxa and Relative Abundance in Bear Creek, 1981

Station Location	001 Bear Creek downstream Darrock Creek	002 Pine Creek at confluence Bear Creek	004 NF Bear Creek upstream Bear Creek	008 Bear Creek at Jardine bridge	009 Bear Creek upstream Pole Creek	010 Bear Creek upstream Palmer Creek	006 Bear Creek at confluence
Plecoptera							
Doroneunia theodora	X C	X C	X C	X C	X C	X C	X C
Magarcys sp.	X C	X C	X C	X C	X C	X C	X C
Cultus sp.	X U	X U	X U		X U		
Yaroperla brevis	X R	X R	X R				X R
Nemoura arctica	X R						
Prostoia besametsa	X R		X R				
Visoka cataractae			X R				
Zapada oregonesis (group)	X U	X U	X U	X U		X U	
Zapada frigida	X R						
Zapada cinctipes	X C	X C	X C	X C	X C	X C	X C
Zapada columbiana	X U	X U	X U	X U	X U	X C	X C
Chloroperlidae	X A	X A	X A	X A	X A	X A	X A
Capniidae	X C	X C	X C	X C	X C	X C	X C
Ephemeroptera							
Cinygmula sp.	X U	X U	X U	X U	X C	X C	X C
Rhithrogena robusta	X A	X A	X A	X A	X A	X A	X A
Rhithrogena sp.	X U	X U	X U	X U	X U	X U	X U
Epheorus grandis	X C	X C	X C	X C	X C	X C	X C
Epheorus, Iran sp.	X U	X U	X U	X U	X U	X U	X U
Ameletus sp.	X C	X C	X C	X C	X C	X C	X C
Baetis bicaudatus	X C	X C	X C	X C	X C	X C	X C
Baetis intermedius	X C	X C	X C	X C	X C	X C	X C
Baetis sp.	X U	X U	X U	X U	X U	X U	X U
Pseudocloeon sp.			X U		X U		
Ephemerella grandis ingens							X R
Ephemerella doddsi	X C	X C	X C	X C	X C	X C	X C
Ephemerella hystrix	X U	X U	X U		X U		
Ephemerella coloradensis			X U	X U			X U
Ephemerella spinifera	X U		X U	X U	X U		X U
Ephemerella infrequens							X R
Ephemerella teresa	X R						
Ephemerella tibialis				X U		X U	

Appendix 2 (continued)

Station Location	001 Bear Creek downstream Darrock Creek	002 Pine Creek at confluence Bear Creek	004 NF Bear Creek upstream Bear Creek	008 Bear Creek at Jardine Bridge	009 Bear Creek upstream Pole Creek	010 Bear Creek upstream Palmer Creek	006 Bear Creek at confluence
Trichoptera							
Parapsyche sp.	X C	X C	X C	X C	X C	X C	X C
Rhyacophila sp. (4)	X C	X C	X C	X C	X C	X C	X C
Glossosoma sp.	X U			X U		X U	
Micrasema sp.							X U
Chryanda centralis				X R			
Ecclisomyia bilera	X U	X U	X U	X U	X U	X U	X U
Rossiana montana	X C	X C	X C	X C	X C	X C	X C
Cryptochia sp.			X R				
Apatania sp.			X U	X U			
Neothremma sp.			X R				
Eccliscosmoecus scylla				X R		X R	
Limnephilus sp.						X R	X R
Coleoptera							
Heterlimnius sp.	X R		X R			X R	
Amphizoa sp.					X R		
Diptera							
Hexatoma sp.	X U	X U	X U	X U	X U	X U	X U
Dicranota sp.	X C	X C	X C	X C	X C	X C	X C
Tipula sp.				X R	X R	X R	
Antocha sp.						X R	
Blephariceridae	X U		X U				X U
Simulidae	X U		X U	X U	X U	X U	X U
Ceratopogonidae				X R			
Empididae	X U	X U	X U	X U	X U	X U	X U
Chironomidae	X C	X C	X C	X C	X C	X C	X C
Other							
Hirudinea	X C	X C	X C	X C	X C	X C	X C
Total Taxa	38	29	41	35	32	34	34

[a] Four individual species recognized (3 of common occurrence and 1 uncommon to rare)

X indicates presence of taxa

R = rare, U = uncommon, C = common, A = abundant

Appendix 3

Birds Recorded Along Survey Transects
May-July, 1981-1982

Common name	Scientific name
American robin	Turdus migratorius
Black-billed magpie	Pica pica
Brewer's blackbird	Euphagus cynocephalus
Cassin's finch	Carpodacus cassinii
Chipping sparrow	Spizella passerina
Clark's nutcracker	Nucifraga columbiana
Common flicker	Colaptes sp.
Common raven	Corvus corax
Common yellowthroat	Geothlypis trichas
Downy woodpecker	Dendrocopos pubescens
Flycatcher	Empidonax sp.
Gray jay	Perisoreus canadensis
Gray-crowned rosy finch	Leucosticte tephrocotis
Hermit thrush	Hylocichla guttata
House wren	Troglodytes aedon
Lark sparrow	Chondestes grammacus
Lazuli bunting	Passerina amoena
Mourning dove	Zenaida macroura
Mountain bluebird	Sialia currucoides
Mountain chickadee	Parus gambeli
Ovenbird	Seiurus aurocapillus
Pine grosbeak	Pinicola enucleator
Pine siskin	Spinus pinus
Red crossbill	Loxia curvirostra
Red-breasted nuthatch	Sitta canadensis
Red-eyed vireo	Vireo olivaceus
Rock wren	Salpinctes obsoletus
Ruby-crowned kinglet	Regulus calendula
Savannah sparrow	Passerculus sandwichensis
Starling	Sturnus vulgaris
Stellar's jay	Cyanocitta stelleri
Townsend's solitaire	Myadestes townsendii
Tree swallow	Iridoprocne bicolor
Vesper sparrow	Pooecetes gramineus
Violet-green swallow	Tachycineta thalassina
Warbling vireo	Vireo gilvus
Western meadowlark	Sturnella neglecta
Western tanager	Piranga ludoviciana
White-crowned sparrow	Zonotrichia leucophrys
White-throated swift	Aeronautes saxatalis
White-throated sparrow	Zontrichia albicollis
Williamson's sapsucker	Sphyrapicus thyroideus
Yellow-rumped warbler	Dendroica sp.

Appendix 4

Scientific Names of Wildlife Species

Common name	Scientific name
Mammals	
Bighorn sheep	*Ovis canadensis*
Bison	*Bison bison*
Black bear	*Ursus americanus*
Bobcat	*Lynx rufus*
Caribou	*Rangifer tarandus*
Columbian ground squirrel	*Spermophilus columbianus*
Common shrew	*Sorex cinerus*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Elk	*Cervus elaphus*
Gray wolf	*Canis lupus*
Grizzly bear	*Ursus arctos*
Marten	*Martes americana*
Meadow vole	*Microtus pennsylvanicus*
Moose	*Alces alces*
Mountain cottontail	*Sylvilagus nuttalli*
Mountain lion	*Felis concolor*
Mule deer	*Odocoileus hemionus*
Northern flying squirrel	*Glaucomys sabrinus*
Porcupine	*Erethizon dorsatum*
Red fox	*Vulpes fulva*
Red squirrel	*Tamiasciurus hudsonicus*
Red-backed vole	*Clethrionomys gapperi*
Snowshoe hare	*Lepus americanus*
Weasel	*Mustela* sp.
Western jumping mouse	*Zapus princeps*
White-tailed jackrabbit	*Lepus townsendii*
Yellow pine chipmunk	*Eutamias amoenus*
Yellow-bellied marmot	*Marmota flaviventris*
Birds	
American kestrel	*Falco sparverius*
Bald eagle	*Haliaeetus leucocephalus*
Blue grouse	*Dendragapus obscurus*
Blue-winged teal	*Anas discors*
Chipping sparrow	*Spizella passerina*
Common merganser	*Mergus merganser*
Dark-eyed junco	*Junco hyemalis*
Gadwall	*Anas strepera*
Golden eagle	*Aquila chrysaetos*
Goshawk	*Accipiter cooperii*
Great horned owl	*Bubo virginianus*
Green-winged teal	*Anas carolinensis*
Long-eared owl	*Asio otus*
Mallard	*Anas platyrhynchos*

Appendix 4 (continued)

Common name	Scientific name
Birds (continued)	
Merlin	*Falco columbarius*
Mountain chickadee	*Parus gambeli*
Northern harrier	*Circus cyaneus*
Osprey	*Pandion haliaetus*
Peregrine falcon	*Falco peregrinus*
Pintail	*Anas acuta*
Prairie falcon	*Falco mexicanus*
Red-tailed hawk	*Buteo jamaicensis*
Robin	*Turdus migratorius*
Ruffed grouse	*Bonasa umbellus*
Sharp-shinned hawk	*Accipiter striatus*
Short-eared owl	*Asio flammeus*
Swainson's hawk	*Buteo swainsoni*
Reptiles and Amphibians	
Garter snake	*Thamnophis* sp.
Prairie rattlesnake	*Crotalus viridis*
Racer	*Coluber* sp.
Spotted frog	*Rana pretiosa*

Appendix 5

Scientific Names of Plant Species

Common name	Scientific name
Grasses	
Beardless wheatgrass	*Agropyron inerme*
Blue wildrye	*Elymus glaucus*
Bluebunch wheatgrass	*Agropyron spicatum*
Canada bluegrass	*Poa compressa*
Columbia needlegrass	*Stipa occidentalis*
Elk sedge	*Carex geyeri*
Fowl bluegrass	*Poa palustris*
Green needlegrass	*Stipa viridula*
Hard fescue	*Festuca ovina*
Idaho fescue	*Festuca idahoensis*
Indian ricegrass	*Oryzopsis hymenoides*
Kentucky bluegrass	*Poa pratensis*
Meadow foxtail	*Alopecurus pratensis*
Mountain brome	*Bromus marginatus*
Pinegrass	*Calamagrostis rubescens*
Prairie junegrass	*Koeleria cristata*
Slender wheatgrass	*Agropyron trachycaulum*
Smooth brome	*Bromus inermis*
Timothy	*Phleum* sp.
Western wheatgrass	*Agropyron smithii*
Forbs	
Alsike clover	*Trifolium hydridum*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Clover	*Trifolium* sp.
Common horsetail	*Equisetum* sp.
Cow parsnip	*Heracleum lanatum*
Fireweed	*Epilobium angustifolium*
Heartleaf arnica	*Arnica cordifolia*
Many-flowered phlox	*Phlox multiflora*
Rocky mountain helianthella	*Helianthella uniflora*
Rose pussytoes	*Antennaria* sp.
Showy aster	*Aster conspicuus*
Silky lupine	*Lupinus sericeus*
Starry Solomon's seal	*Smilacina stellata*
Sticky geranium	*Geranium viscosissimum*
Sulfur buckwheat	*Eriogonum umbellatum*
Sweetscented bedstraw	*Galium triflorum*
Thickstem aster	*Aster integrifolius*
Twinflower	*Linnaea borealis*
Weedy milkvetch	*Astragalus miser*
Western meadowrue	*Thalictrum occidentale*
Yarrow	*Achillea millefolium*
Shrubs	
Big sagebrush	*Artemisia tridentata*
Blue huckleberry	*Vaccinium globulare*

Appendix 5 (continued)

Common name	Scientific name
Shrubs (continued)	
Common snowberry	Symphoricarpos albus
Gooseberry	Ribes sp.
Green rabbitbrush	Chrysothamnus viscidiflorus
Honeysuckle	Lonicera utahensis
Prickly rose	Rosa acicularis
Rocky mountain juniper	Juniperus scopulorum
Serviceberry	Amelanchier sp.
Shiny-leaf spirea	Spiraea betulifolia
Smooth currant	Ribes inerme
Thimbleberry	Rubus parviflorus
Wood's rose	Rosa woodsii
Trees	
Douglas-fir	Pseudotsuga menziesii
Engelmann spruce	Picea engelmannii
Lodgepole pine	Pinus contorta
Quaking aspen	Populus tremuloides
Subalpine fir	Abies lasiocarpa
Whitebark pine	Pinus albicaulis

Appendix 6

More information is available each year about earthquake occurrences and their effects in south central Montana. Starting in 1897 through roughly 1959, most of the available information about earthquakes in the region were based on local residents' observation (Modified Mercalli Scale) and, in some cases, on sensitive monitoring instruments located as far away as Log Angeles, California.

After 1959, the number of earthquake-monitoring devices in the region increased dramatically, as did the precision of locating earthquakes. Using both historical accounts and more recent seismographic and geophysical records, estimates were made as to the recurrence time and intensity of earthquake ground shaking that the Jardine minesite would likely experience over time. Estimates were calculated for both bedrock (Table App. 6-1A) and for unconsolidated surficial material (table App. 6-1B). Table App 6-2 lists the Modified Mercalli Scale--a set of criteria used to describe the degree of ground shaking as perceived by local residents. Ground shaking equal to that experienced during the 1959 earthquake--intensity VI at Jardine--would be expected roughly once every 50 years. Ground shaking strong enough to damage well-built buildings (intensity IX) would occur once every 7,000 years.

The values for recurrence times and the amount of ground shaking are best approximations based on limited data and should be used to give only a relative idea of the possible frequency and degree of ground shaking the minesite may incur over time.

The location, strength, and timing of earthquakes in Montana cannot be predicted. Based on the available data, however, the probability of an earthquake causing serious structural damage to well-built structures in the Jardine/Gardiner area over the 20-year operating life of the mine is very low.

Table 6-1A. Estimated return times, peak motion values and duration of ground shaking for various intensity earthquakes at the minesite

A. Bedrock

	Modified Mercalli Intensity					
	V	VI	VII	VIII	IX	X
Recurrence time (years)	22	50	196	869	7,147	73,405
Peak horizontal acceleration (g)	0.03	0.06	0.12	0.25	0.50	0.99
Peak horizontal velocity (cm/sec)	4.2	7.4	13.2	23.4	41.6	74.1
Peak horizontal displacement (cm)	2.6	4.1	6.3	9.8	15.1	23.4
Duration of shaking (sec)	24.8	18.1	15.3	14.4	19.1	31.5

B. Surface Material[1]

	Modified Mercalli Intensity					
	V	VI	VII	VIII	IX	X
Recurrence time (years)	22	50	196	869	7,147	73,405
Peak horizontal acceleration (g)	0.05	0.07	0.11	0.19	0.33	0.65
Peak horizontal velocity (cm/sec)	6.1	8.1	11.9	18.6	29.7	52.2
Peak horizontal displacement (cm)	3.5	4.4	5.8	8.2	11.7	18.0
Duration of shaking (sec) Table 1.C.4	34.8	28.1	25.3	24.4	29.1	42.5

Source: Jardine Joint Venture Application, 1984, p. 1-C-39 and p. 1-C-44.

[1] Peak motion values and duration of shaking surficial material were derived from values calculated for bedrock based upon research by Seed et al. (1976).

Table App. 6-2. Modified Mercalli Intensity Scale of 1931 (abridged)

I. Not felt except by a very few under especially favorable circumstances.

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize the motion as an earthquake. Standing motor cars may rock slightly. Vibration similar to that of a passing truck.

IV. During the day, felt indoors by many; felt outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation similar to that of a heavy truck striking building. Standing motor cars rock noticeably.

V. Felt by nearly everyone; many awakened. Some dishes and windows broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes notices. Pendulum clocks may stop.

VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of falling plaster or damaged chimneys. Damage slight.

VII. Almost everyone frightened. Damage negligible in buildings of good design and construction; slight to moderate in well-built, ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken. Noticed by persons driving motor cars.

VIII. Damage slight in specially designed structures; considerable in ordinary, substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Destruction of chimneys, factory stacks. columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected from ground in small amounts. Changes in well water. Persons driving motor cars disturbed.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; damage great in substantial buildings thrown out of plumb; damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

X. Some well-built, wooden structures destroyed; most masonry and frame structures destroyed with foundations. Ground badly cracked. Rails bent. Considerable amount of landslides from river banks and steep slopes. Shifted sand and mud. Water splashed over banks.

Appendix 7

Personal Income--Park County (thousands of 1980 dollars)

Item	1973	1977	1978	1979	1980	1981	1982	1983
Total personal income[1]	$85,715	$92,152	$101,143	$104,946	$102,703	$104,825	$102,603	$101,133
Nonfarm personal income[2]	75,770	90,641	96,263	99,857	98,409	101,727	101,049	100,250
Farm personal income	9,945	1,511	4,880	5,089	4,294	3,098	1,554	883
Derivation of personal income								
Total earnings by type of work[3]	60,466	62,131	68,781	69,896	64,827	63,559	57,413	55,919
Less: personal contribution for social insurance	3,458	4,575	3,903	4,179	4,019	4,604	4,565	4,542
Plus: residence adjustment	1,120	1,371	1,435	1,439	1,854	1,880	2,069	1,811
Equals: net earnings	58,128	58,927	66,313	67,155	62,662	60,835	54,917	53,188
Plus: dividends, interest, and rent[4]	16,563	19,744	21,286	23,652	24,525	27,676	30,036	29,787
Plus: transfer payments	11,023	13,481	13,544	14,138	15,516	16,314	17,651	18,158
Population: thousands	11.7	12.4	12.8	13.0	13.0	13.5	13.4	13.4
Per capita personal income (not in thousands of dollars)	7,347	7,427	7,914	8,094	7,914	7,782	7,673	7,546
Components of earnings								
Wages and salaries	43,859	50,665	53,747	56,067	53,356	51,568	49,302	47,224
Other labor income	2,572	4,012	4,246	4,148	3,936	3,764	4,209	4,297
Proprietors' income[5]	14,035	7,465	10,788	9,680	7,535	8,228	-3,902	4,398
Farm	7,484	-545	2,639	2,487	1,742	790	-966	-1,532
Nonfarm	6,551	8,009	8,149	7,193	5,793	7,438	4,868	5,930

Source: U.S. Department of Commerce, Bureau of Economic Analysis, April 1985, Table 5.00.

[1] Income figures are adjusted for inflation using the deflator for personal consumption expenditures as cited in the Survey of Current Business, July issues 1975, 1977, 1979, 1982, and 1984.

[2] Nonfarm personal income equals total personal income less farm earnings (labor and proprietors' income.

[3] Earnings consist of wage and salary disbursements, other labor income, and proprietors' income.

[4] Dividends, interest, and rent include a capital consumption adjustment for retal income.

[5] Proprietors' income includes inventory valuation and capital consumption adjustments for nonfarm proprietors.

Appendix 8

Earnings by Industry--Park County[1] (thousands of 1980 dollars)

Earnings by industry	1973	1977	1978	1979	1980	1981	1982	1983
Total earned income	$60,466	$62,131	$68,781	$69,896	$64,827	$63,559	$57,413	$56,077
Farm	9,961	1,511	4,880	5,089	4,294	3,098	1,555	886
Nonfarm	50,505	60,620	63,901	64,807	60,533	60,462	55,858	55,191
Private	43,488	52,908	55,992	56,778	52,446	52,073	47,496	46,233
Agricultural services, forestry, fisheries, and other[2]	312	622	556	573	584	316	266	(D)
Mining	(L)	(L)	(L)	178	236	207	(L)	(D)
Construction	3,119	4,720	5,077	4,250	3,150	4,021	4,872	3,562
Manufacturing	4,925	6,891	7,386	7,205	5,353	5,043	4,311	4,687
Non-durable goods	1,067	1,552	1,672	1,944	2,016	1,240	1,209	1,176
Durable goods	3,858	5,339	5,713	5,261	3,337	3,804	3,102	3,511
Transportation, communication and public utilities	16,868	20,159	21,539	23,247	22,069	20,724	18,069	15,932
Wholesale trade	853	837	844	859	784	1,266	1,566	1,394
Retail trade	7,720	8,245	8,256	8,097	7,617	8,829	8,119	8,140
Finance, insurance, and real estate	2,287	3,101	3,461	3,485	3,217	2,523	2,234	2,328
Services	7,336	8,291	8,848	8,883	9,436	9,392	8,451	9,736
Government	7,017	7,711	7,909	8,029	8,087	8,140	8,363	8,958
Federal, civilian	1,298	1,232	1,289	1,300	1,345	1,425	1,291	1,325
Federal, military	260	213	220	218	223	200	208	266
State and local	5,460	6,266	6,400	6,511	6,519	6,516	6,864	7,367

Source: U.S. Department of Commerce, Bureau of Economic Analysis, April 1985, Table 5.00.

[1] Earnings have been deflated to 1980 dollars using the implicit price deflator for personal consumption expenditures, Survey of Current Business, July issues, 1975, 1977, 1979, 1982, and 1984.

[2] Other includes wages and salaries of U.S. citizens working for international organizations in the United States.

(L) means less than $50,000 and (D) indicates that data is not shown to avoid disclosure of confidential information. Numbers may not total correctly due to rounding.

Appendix 9

Park County Employment by Type of Work[1]

Employment by type of work	1970	1976	1977	1978	1979	1980	1981	1982
Total employment by type of work	4,526	5,167	5,391	5,648	5,827	5,634	5,573	5,536
Wage and salary								
Farm	217	206	176	178	210	199	199	197
Nonfarm	3,234	3,944	4,108	4,314	4,423	4,186	4,109	4,048
Total wage and salary	3,451	4,150	4,284	4,492	4,633	4,385	4,308	4,245
Private employment								
Agricultural services, forestry, and fisheries	23	20	20	18	19	19	22	23
Mining	0	0	0	0	(L)	10	14	(L)
Construction	102	163	201	217	199	167	164	219
Manufacturing	264	483	456	473	474	380	333	293
Non-durable goods	113	114	129	134	166	167	97	85
Durable goods	151	369	327	339	308	213	236	208
Transportation and public utilities	749	778	883	918	945	928	880	797
Wholesale trade	20	34	38	44	43	41	41	46
Retail trade	648	860	778	825	830	782	828	812
Finance, insurance and real estate	178	185	199	242	237	237	203	179
Services	700	765	885	906	966	942	930	956
Total private employment	2,661	3,288	3,460	3,643	3,722	3,506	3,415	3,328
Government employment								
Federal	169	168	150	157	161	160	152	142
State and local	404	488	498	514	540	520	542	578
Total government employment	563	656	648	671	701	680	694	720
Number of proprietors								
Farm proprietors	399	346	349	346	346	346	346	346
Non-farm proprietors	653	671	758	810	848	903	919	945
Total proprietors	1,052	1,017	1,107	1,156	1,194	1,249	1,265	1,291

Source: U.S. Department of Commerce, Bureau of Economic Analysis, April 1984, and Census and Economic Information Center, 1983.

[1] Also known as "place of work." Employment estimates for 1976-1982 are based on 1972 Standard Industrial Codes. Estimates of 1970 employment are based on 1967 Standard Industrial Codes.

(L) This symbol indicates fewer than 10 jobs; however, the number is included in totals.

Appendix 10

Water Quality Standards for A-1 and B-1 Streams

ARM 16.20.617 A-1 CLASSIFICATION (1) Waters classified A-1 are suitable for drinking, culinary, and food processing purposes after conventional treatment for removal of naturally present impurities.

(2) Water quality must be suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(3) For waters classified A-1 the following specific water quality standards shall not be violated by any person:

(a) The geometric mean number of organisms in the coliform group must not exceed 50 per 100 milliliters if resulting from domestic sewage.

(b) Dissolved oxygen concentration must not be reduced below 7.0 milligrams per liter.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) No increase above naturally occurring turbidity is allowed except as permitted in ARM 16.20.633.

(e) A 1°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 66°F; within the naturally occurring range of 66°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than two units above naturally occurring color.

(h) Concentrations of toxic or other deleterious substances which would remain in the water after conventional water treatment must not exceed the maximum contaminant levels set forth in the 1975 National Interim Primary Drinking Water Standards (40 CFR Part 141) or subsequent revisions or the 1979 National Secondary Drinking Water Standards (40 CFR Part 143) or subsequent revisions. The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bioassay or other methods. The values listed in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318-79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with section 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water.

(4) The board hereby adopts and incorporates by reference "EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318-79739)", which set forth water quality criteria for toxic or other deleterious substances. Copies of this document may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-301 MCA; IMP, Sec. 75-5-301 MCA; Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1984 MAR p. 1802, Eff. 12/14/84.)

ARM 16.20.618 B-1 CLASSIFICATION (1) Waters classified B-1 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(2) For waters classified B-1 the following specific water quality standards shall not be violated by any person:

(a) During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters.

(b) Dissolved oxygen concentration must not be reduced below 7.0 milligrams per liter.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) The maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units except as permitted in ARM 16.20.633.

(e) A 1°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 66°F; within the naturally occurring range of 66°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F per hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F. This applies to all waters in the state classified B-1 except for Prickly Pear Creek from McClellan Creek to the Montana Highway No. 433 crossing where a 2°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 65°F; within the naturally occurring range of 65°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than five units above naturally occurring color.

(h) Concentrations of toxic or other deleterious substances which would remain in the water after conventional water treatment must not exceed the maximum contaminant levels set forth in the 1975 National Interim Primary Drinking Water Standards (40 CFR Part 141) or subsequent revisions or the 1979 National Secondary Drinking Water Standards (40 CFR Part 143) or subsequent revisions. The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bioassay or other methods. The values listed in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318-79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with section 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water.

(3) The board hereby adopts and incorporates by reference "EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318-79379)", which set forth water quality criteria for toxic or other deleterious substances. Copies of this document may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciencies, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-301 MCA; IMP, Sec. 75-5-301 MCA; Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84.)

Appendix 11

Description of Reagents Used in Ore Beneficiation

Five different reagents would be used in the ore beneficiation process. These include sodium cyanide, Aerofloat 208, Aero 350 Xanthate, Aerofroth 76, and Separan NP10. Table III-3 presents the application rate of each reagents, based on a production rate of 750 tons of ore per day. Mill circuit waste water would be expected to contain concentrations of these reagents in different chemical compositions. These wastes would be moved to the lined tailings dump or would be backfilled in the mine stopes. This appendix will describe both the physical characteristics and toxicity of each reagent used in the ore beneficiation process.

Sodium Cyanide

Sodium cyanide is a simple alkali metal salt which dissociates in aqueous solution. Upon dissociation, the cyanide ion combines with a hydrogen ion to form hydrocyanic acid (HCN) (Dupont, no date). Although highly toxic to aquatic life, HCN occurs only rarely in nature due to the reactivity of the molecule. In the environment, cyanides are connected to other compounds, or they form complexes with trace metals. The stability of metallocyanide complexes is highly variable. For example, complexes formed with zinc and cadmium are unstable, while those formed with cobalt and iron are very stable. The iron cyanides however, dissociate to release toxic cyanide ions in the presence of sunlight. Photo-chemical degradation of ferrocyanide and ferric cyanide is considered the major environmental concern regarding persistence of cyanide in the environment.

Aquatics. Almost all aquatic toxicological studies have been directed toward measuring the effect of free cyanides on aquatic organisms. Little information has been developed discussing the fate of cyanides, cyano complexes, and cyanates in the environment.

Human Responses. The following inhalation toxicity data are estimated human responses to various concentrations of HCN (National Institute of Occupational Safety and Health, 1976):

330 ppm.......	Rapidly fatal if no emergency aid is administered
100-200 ppm	Fatal within 1/2 to 1 hour
45-54 ppm.......	Tolerated for 1/2 to 1 hour without immediate or delayed effects
20-40 ppm.......	Slight symptoms after several hours
10 ppm.......	Threshold limit/time-weighted average for a normal 8-hour workday
2-5 ppm.......	Odor threshold

Cyanide ingested by humans at quantities of 10 milligrams or less per day is not toxic and is biotransformed to the less-toxic thiocyanate. Continuous long-term consumption of up to 5 milligrams per day has shown no injurious effects. Lethal toxic effects from the ingestion of water containing cyanide occur only when cyanide concentrations are high and overwhelm the detoxifying mechanisms of the human body (Environmental Protection Agency, 1976).

Fisheries. A review of available data on acute toxicity of simple cyanides to fish reveals the following minimum lethal concentrations:

Brook Trout -- 0.05 mg/l
Rainbow Trout -- 0.07 mg/l
Brown Trout -- 0.07 mg/l

The Environmental Protection Agency (EPA) has concluded that free cyanide concentrations in the range of 0.05 to 0.10 mg/l as cyanide have proven eventually fatal to many sensitive fishes. Levels above 0.20 mg/l are probably rapidly fatal to most fish species. (Environmental Protection Agency, 1976)

Although HCN is the most toxic form of cyanide in water, the ratio of HCN to total cyanide is variable and depends on pH, temperature, soils, natural oxidants, bacteria, and photochemical actions. For these reasons, the EPA cyanide criteria of 0.005 mg/l is based on the concentration of total cyanide.

A workshop sponsored by the National Science Foundation suggests that further research needs to be completed regarding the fate and toxicity of cyanide in the environment (National Science Foundation, 1983).

Aerofloat 208

Aerofloat 208 is a phosphorodithioate salt used in mineral separation during the ore beneficiation process.

The acute oral LD_{50} (lethal dose for 50% of the exposed group) for rats is 8.46 grams per kilogram of body weight. Marked eye irritation and skin corrosion were produced during primary irritation studies with rabbits.

Engineering controls are not needed to protect workers from exposure if good hygiene practices are strictly followed.

Aero 350 Xanthate

Aero 350 Xanthate is an alkylxanthate salt used as a reagent in the ore beneficiation process. The acute oral LD_{50} for rats is between 1.0 and 2.0 grams per kilogram of body weight. Airborne dust may cause significant eye and skin irritations or irritation of the respiratory tract.

Aero 350 xanthate should be used in a closed-ventilation system. Where engineering controls are effective, respiratory protection is generally not required. Aero 350 Xanthate must be stored in a cool, dry, well-ventilated area.

Aerofroth 76

Aerofroth 76 is classified as an alcohol. It is used as a reagent in the ore beneficiation process. The acute oral LD_{50} for rats is 3.2 grams per kilogram of body weight.

Aerofroth 76 is a combustible liquid that would be harmful if inhaled and that would cause eye and skin irritation. Good enclosure and local exhaust ventilation should be provided to minimize exposure.

Separan NP10

Separan NP10 is a hydrolyzed polyacrylamide that appears as a white, free flowing, amorphous solid with little odor. The acute oral LD_{50} is 2 grams per kilogram of body weight.

Separan NP10 could cause slight transient eye irritation. Reasonable caution and personal cleanliness should be taken in handling and storage.

Appendix 12

Plant Species Important to Grizzly Bears

Scientific names	Common names
Shrubs	
Arctostaphylos uva-ursi	Kinnikinnick
Crateagus douglasii	Black hawthorn
Rhamnus alnifolia	Alderleaf buckthorn
Ribes spp.	Currant
_Sheperdia canadensis_*	Buffaloberry
Vaccinium caespitosum	Dwarf huckleberry
_V. globulare_*	Blue huckleberry
_V. scoparium_*	Grouse whortleberry
Forbs	
Cirsium arvense	Canada thistle
C. foliosum	Elk thistle
_Claytonia lanceolata_*	Lanceleaf springbeauty
_Epilobium angustifolium_*	Fireweed
Robust Epilobium spp. (e.g. _E. glandulosum_)	Fireweed
_Equisetum arvense_*	Horsetail
Equisetum spp.	Horsetail
Fragaria vesca	Woodland strawberry
_F. virginiana_*	Strawberry
Heracleum lanatum	Cowparsnip
_Lomatium foeniculaceum_*	Biscuitroot
L. dissectum	Desert parsley
L. triternatum	Nineleaf lomatium
_Perideridia gairdneri_*	Yampa
_Polygonum bistortoides_*	American bistort
Robust Polygonum spp. (e.g. _P. amphibium_)	Knotweed
Potamogeton spp. (_P. natans_, _alpinus_, etc.)	Pondweed
Streptopus amplexifolius	Twistedstalk
Taraxacum spp. (_T. officinale_, _ceratophorum_, etc.)*	Dandelion
_Trifolium hybridum_*	Alsike clover
_T. longipes_*	Longstalk clover
_T. repens_*	White clover
Graminoids	
Agropyron spp.	Wheatgrasses
Bromus spp.	Brome grasses
Calamagrostis spp.*	Pinegrass, reedgrass
Carex spp.*	Sedges
Deschampsia spp.*	Hairgrasses
Festuca spp.	Fescues
Melica spp.*	Oniongrasses
Phleum spp.*	Timothy
Poa spp.*	Bluegrasses
Scirpus spp.	Bulrushes

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*Food items especially well-represented in the diet.

Appendix 13

Trail Data in the Jardine Area

Name	Use Level[1]	Period
LaDuke Trail	H	10/15 - 11/30
	L	12/01 - 10/14
Little Trail Creek & Maiden Basin	H	10/15 - 11/30
	L	12/01 - 10/14
North Fork Bear Creek	H	10/15 - 11/30
	L	12/01 - 10/14
Bear Creek Trail	H	10/15 - 11/30
(Jardine to Darroch Creek)	L	12/01 - 10/14
Bear Creek Trail	H	07/01 - 09/30
(Darroch to Castle Lake)	L	10/01 - 06/30
Bear Creek Trail (Castle Lake to Monitor Park)	L	Year round
Bear Creek Trail	H	07/01 - 09/30
(Caste Lake Junction to Horse Creek)	L	10/01 - 06/30
Jardine/Hellroaring Trail	H	07/15 - 10/15
(High and low routes)	L	10/16 - 07/14
Palmer Mountain Trail	H	07/01 - 11/30
	L	12/01 - 06/30
Crevice Trail	H	10/15 - 11/30
(Park Line Trail)	L	12/01 - 10/14

Source: Tom Puchlerz, Wildlife Biologist, U.S. Forest Service, Gallatin National Forest.

[1] H = High, L = Low

Road Data Jardine CEA

Name	Use Level	Period
Little Trail Creek Road	H	10/15 - 02/15
	L	02/16 - 10/14
C. Haye Residential Road	H	Year round
Eagle Creek Road	H	06/01 - 11/30
(To Pole Creek Road)	Closed	12/01 - 05/30
Pole Creek Road	L	07/01 - 09/30
	Closed	10/01 - 06/30
Eagle Creek System	L	06/01 - 10/15
Above Pole Creek	Closed	10/16 - 05/30
Gardiner/Jardine County Road	H	Year round
Bear Creek Road	H	06/01 - 11/30
	Closed	12/01 - 05/30
Darroch Creek System	L	06/01 - 10/15
Ash Mountain System	H	10/16 - 11/30
	Closed	12/01 - 05/30
Bear Fork Road System	L	06/01 - 10/15
	H	10/16 - 11/30
	Closed	12/01 - 05/30
Bald Mountain Road	L	06/01 - 10/15
	H	10/16 - 11/30
	Closed	12/01 - 05/30
Jardine Mining Roads (Private)	H	Year round

Appendix 14

Land, Soil, and Water Conservation Practices to Control Erosion and Sediment Loading

Best Management Practices (BMP) to control soil erosion are outlined in the draft Soil and Water Conservation Practices Handbook, as amended February 1986. This Forest Service handbook #2509.22 lists BMPs which would be used to control sediment from the JJV project. Erosion-control practices include, but are not limited to:

a. Facilities area:

Revegetation of disturbed areas - All areas disturbed by construction activities that are not used for roads, parking areas, buildings, etc., will be topsoiled and seeded as soon as practical. Included are road cut fill slopes, settling basin ditches, and areas around buildings.

Diversion and runoff - Runoff from the facilities area will be collected in settling basins. Settling basins will be constructed prior to disturbance.

Ditch blocks (sediment traps) - Ditch blocks will be constructed in roads, diversion, or collection ditches to retard flow velocity and sediment transport. The location and number of these structures will be determined on-site as construction progresses.

b. Minesite:

Diversion ditch - Above portals and waste dumps to divert drainage from undisturbed areas away from disturbances.

Settling basins - Runoff from disturbances will be collected in settling basins. These will be constructed prior to initiating disturbance.

Revegetation - Basin dikes, ditch banks, road ditch slopes and areas disturbed during construction that need not be left barren during operation will be revegetated as soon as practical.

c. Impoundment Area:

Diversion ditches - Above the impoundment area and related facilities to divert drainage from undisturbed areas away from this operation.

Settling basin - Runoff from the exterior slopes of the impoundment dikes, recycle pond, and surge pond will be collected for settling of sediment.

Revegetation - Dike slopes, ditch banks, road cuts and fills, and associated disturbances will be revegetated as soon as practical.

d. Roads:

Ditch blocks - Along ditches on an as-needed basis to prevent erosion and limit sediment transport.

Drainage structures - Maintain natural drainage patterns to prevent ponding, maintain natural flow conditions and prevent erosion of road slopes. Inlet and outlet protection will be designed on a site-specific basis to prevent erosion.

Revegetation - Road and ditch banks and other disturbed areas associated with road construction will be revegetated as soon as practical.

The following sediment plan was submitted to the Department in February 1986:

Jardine Joint Venture Project Sediment Control Plan

The Jardine Joint Venture Project (JJV) will be designed, constructed, and operated to minimize sediment contribution to Bear Creek and the Yellowstone River. The principal components of the sediment control plan are diversion above disturbed areas, runoff control, settling ponds, and revegetation practices as outlined in the Permit Application. The JJV also commits to using water in sedimentation ponds for irrigation or dust suppression when reasonably practical, installing culvert downspouts across road fills, and revegetating road cuts and fills on permanent roads. These procedures are indicated mitigating measures in the JJV Draft Environmental Impact Statement. The control and collection of runoff from disturbed areas in sedimentation ponds will minimize potentially sediment-bearing runoff leaving the mine area and reaching Bear Creek. Prompt revegetation of disturbed areas, including the tailings disposal area, will greatly reduce the erosion potential from the project.

Runoff control ditches will be designed to safely pass the 100-year, 24-hour peak discharge. Sediment ponds will be designed to completely contain the 25-year, 24-hour runoff event and will include spillways designed to pass the 100-year peak discharge. Runoff from mill facilities, topsoil storage areas, and the four portals will be intercepted by ditches and routed to sediment ponds. Location of the ditches and sedimentation ponds are shown on Exhibit II-1. Final design of sediment control structures will be submitted to DSL prior to construction.

Runoff from the tailings disposal area will be contained in the seepage control pond which will include storage for the 100-year runoff event. Runoff from the 0.7 square-mile drainage area upgradient of the tailings disposal area will be diverted around the disturbed area. Runoff from the embankment slope of the tailings facility will be intercepted by the containment ditch of the return water line and will report to the seepage pond or the return water pond (Exhibit II-1). Construction activities will be sequenced so that runoff control ditches and sediment ponds are installed in the initial phase of the soil stripping and construction.

Runoff from the mine facilities will discharge only to Bear Creek when the 25-year, 24-hour event is exceeded, and in the case of runoff from the tailings disposal area only when the 100-year, 24-hour flow event was exceeded. Additionally, any discharge during a runoff event exceeding design capacity will pass through a sediment pond, significantly reducing the sediment load potentially reaching the stream.

Road design and construction will incorporate erosion control procedures and engineering practices to reduce sediment contributions to Bear Creek. Cut and fill stabilization of permanent public roads will include retopsoiling and revegetation. Public road sections that are not upgradient of proposed sediment control ditches and ponds will have ditches and sediment traps constructed to contain runoff (Exhibit II-1). Sediment traps will be located adjacent to the bridge at the stream crossing location. Runoff control ditches and sediment traps will be maintained routinely to remove accumulated sediment. Seeding will take place as soon as practical following topsoil placement during either the spring or fall seasons. Where revegetation is not sufficient, lining of ditches with rip rap, fiber mats, or a rigid lining will be used as necessary. Straw bale sediment traps, energy dissipation structures, channel stabilization, culvert discharge control, culvert downspouts, temporary dikes and berms, and other specialized sediment control practices will be used on a case-by-case basis to control erosion during construction. Best available construction practices will be utilized if bridge installation is necessary, to minimize sediment contribution to Bear Creek.

Final engineering design of all facilities, roads, and sediment control structures will be reviewed and approved by DSL prior to construction.

Appendix 15

Updated Hydrologic Monitoring Plan

Surface Water

Five factors have been taken into consideration in making recommendations regarding an operational surface water monitoring program.

- --The proposed project is located in an environmentally sensitive area.
- --Arsenic contamination related to previous mining activities is well documented.
- --The proposed ore beneficiation process could use the potentially toxic chemical sodium cyanide.
- --Increased sediment loading to Bear Creek would be expected.
- --A septic tank drainfield system would be built near Bear Creek.

The operational surface water quality monitoring program would be based on an evaluation of these factors. Operational monitoring would occur at stations 001A and 010 (see figure II-6) for each year of operation unless otherwise noted. The program would involve the following steps.

- --Monitor baseline water quality parameters (standard analysis, Table 1) seasonally (winter, spring runoff, summer low-flow, fall).
- --Monitor (partial analysis, Table 1) monthly.
- --Statistics, including mean, median, range, high and low values, and number of times measurements exceed criteria, should be tabulated and forwarded to DHES and DSL on a quarterly basis.

Ground Water

A. Return Water Ponds, Sludge Ponds, and Seepage Collection Ponds

Both the seepage control and return water ponds will include a double-lined system with appreciable hydraulic head acting on the liner. the leak detection system, as proposed, represents normal industry practice, but will not detect a small leak through the overlying system unless such a leak produces saturated conditions in the sand drainage blanket over the bentonite-soil mixture. It is recommended that the seepage collection pond and return water pond be outfitted with a designed network of pressure/vacuum lysimeters or their equivalent which can prevent the development of a false sense of security based on a negative reading within the leak detection system.

B. Tailings Impoundment

Although mining wastes are not classified as hazardous under current environmental laws, hazardous materials will be disposed of in the lined tailings dump. For these reasons, the ground water monitoring program should conform with State of Montana guidelines developed for ground water monitoring and hazardous wastes.

TABLE 1

Jardine Joint Venture - Operational Monitoring Plan Analytical Schedule Standard Analysis (S)

Total Suspended Solids (TSS)*
Total Dissolved Solids (TDS)
pH
Specific Conductivity (SC)
Field Temperature (°C)
Total Alkalinity
Total Acidity (pH>7.0)
Hardness
Carbonate (CO_3)
Chloride (Cl)
Sulfate (SO_4)
Calcium (Ca)

Magnesium (Mg)
Sodium (Na)
Potassium (K)
Nitrite plus Nitrate ($NO_2 + NO_3$)
Orthophosphate (as P)
Cyanide (CN)
Arsenic (As)
Cadmium (Cd)
Copper (Cu)
Iron (Fe)
Lead (Pb)
Zinc (Zn)

PARTIAL ANALYSIS (P)

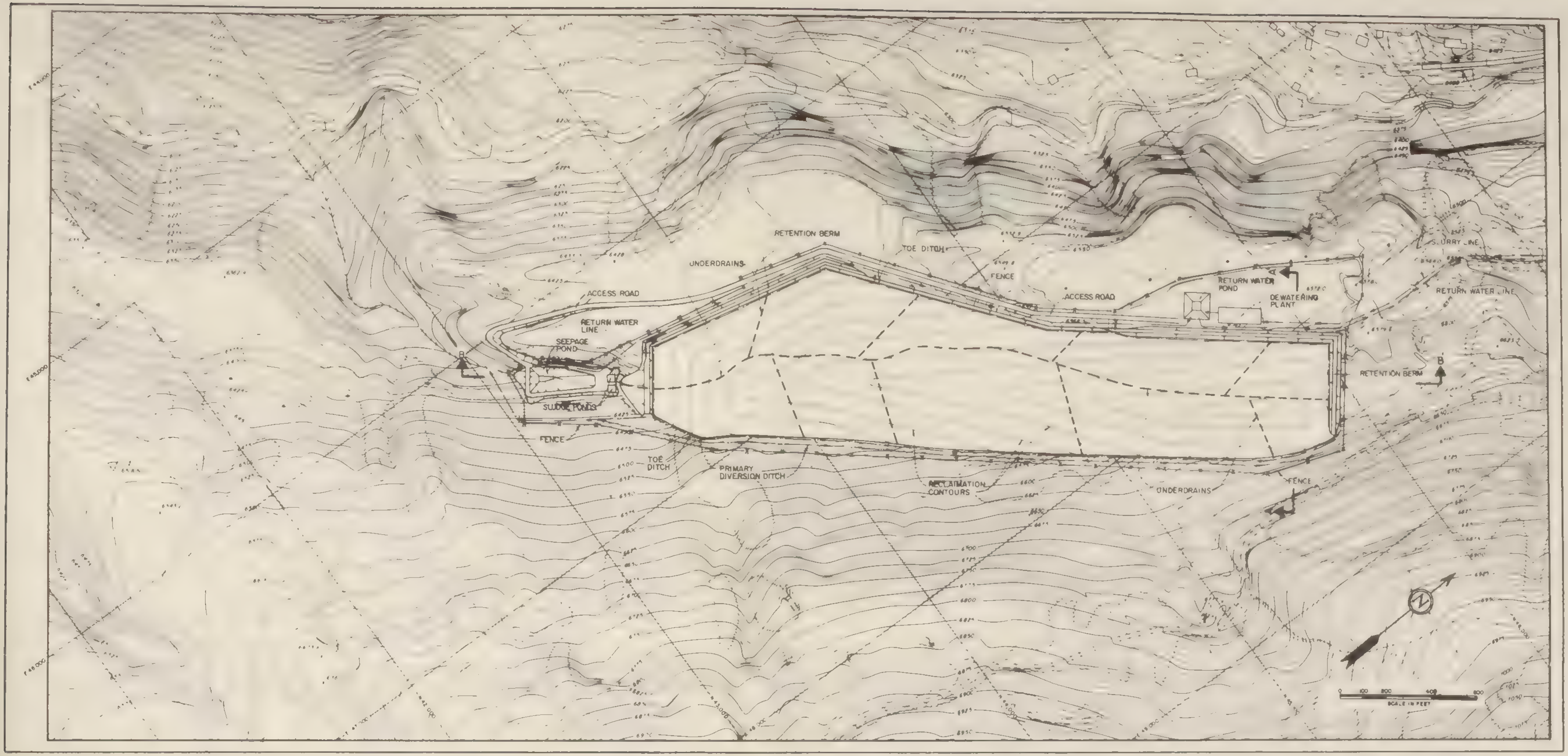
Specific Conductivity (SC)
Field Temperature (°C)
Total Suspended Solids (TSS)*
pH

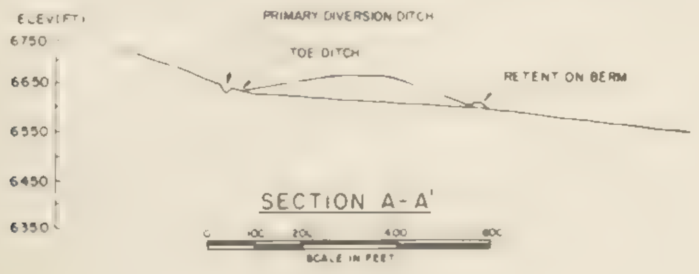
Arsenic
Cyanide
Nitrite plus Nitrate ($NO_2 + NO_3$)

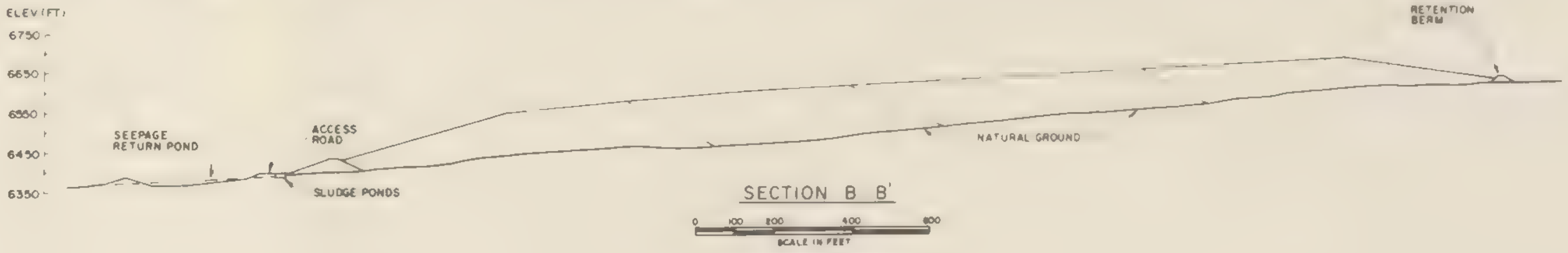
Notes: 1) All metals and arsenic will be analyzed for total recoverable constituents. Ground water samples for metals will be filtered and analyzed for dissolved constituents.

2) Cyanide analysis will be for total CN and CN amenable to chlorination, if total CN is indicated.

* Surface Water Only


RETENTION BERM
TOE DITCH
UNDERDRAINS
FENCE
ACCESS ROAD
RETURN WATER POND
DEWATERING PLANT
SLURRY LINE
RETURN WATER LINE
ACCESS ROAD
RETURN WATER LINE
SEEPAGE POND
SLUDGE PONDS
FENCE
TOE DITCH
PRIMARY DIVERSION DITCH
RECLAMATION CONTOURS
UNDERDRAINS
FENCE
RETENTION BERM
A
B
B'
N
0 100 200 400 800
SCALE IN FEET


ELEV(FT)
6750
6650
6550
6450
6350
PRIMARY DIVERSION DITCH
TOE DITCH
RETENTION BERM
SECTION A-A'
0 100 200 400 800
SCALE IN FEET


ELEV(FT)
6750
6650
6550
6450
6350
RETENTION BERM
SEEPAGE RETURN POND
ACCESS ROAD
SLUDGE PONDS
NATURAL GROUND
SECTION B B'
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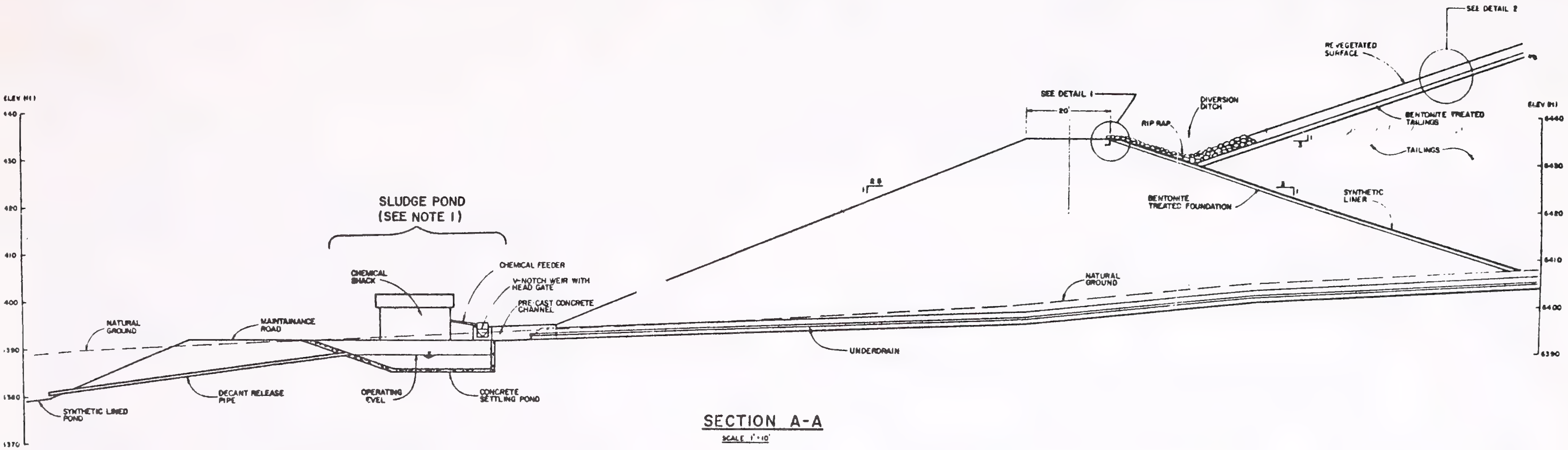
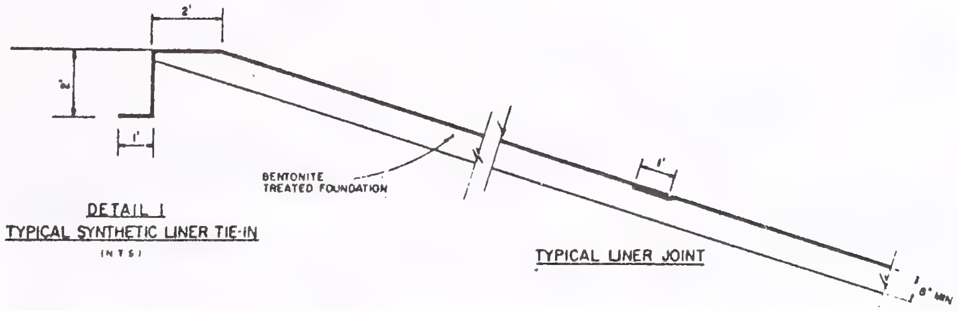
SCALE IN FEET

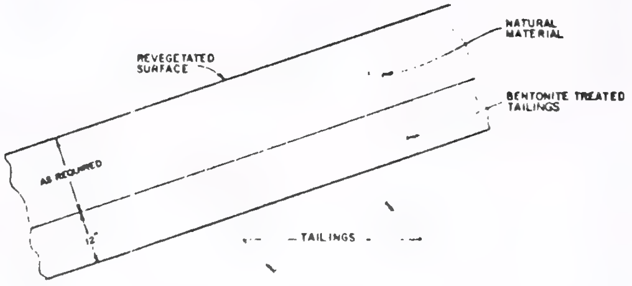


SECTION A-A
SCALE 1"=10'

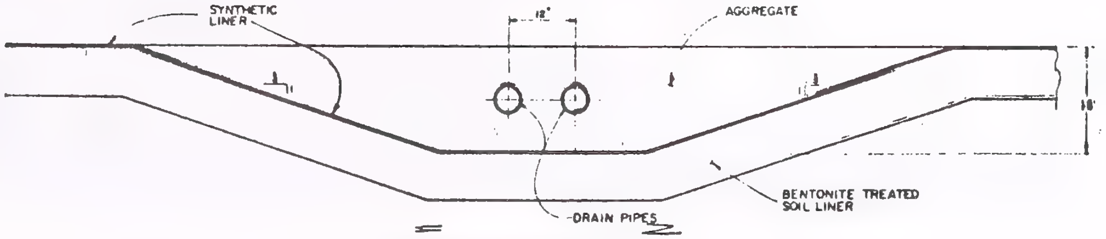


DETAIL 1
TYPICAL SYNTHETIC LINER TIE-IN
(NTS)

TYPICAL LINER JOINT



DETAIL 2 – TYPICAL SECTION
SHOWING RECLAMATION
NTS



UNDERDRAIN TYPICAL SECTION

NOTES
1. Necessity of sludge pond to be verified prior to final design.

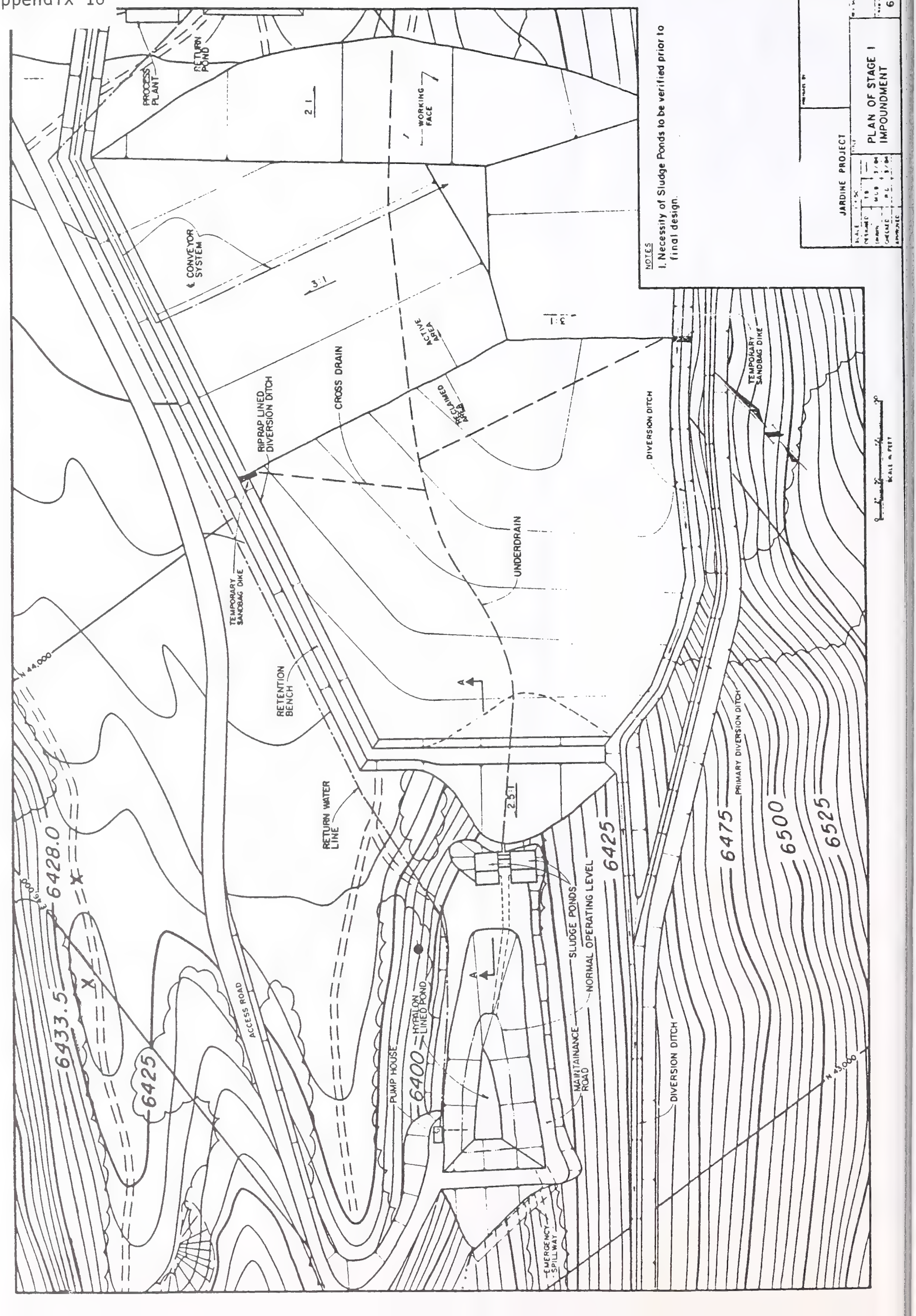
JARDINE PROJECT

SCALE AS SHOWN		
DESIGNED	TS	—
DRAWN	MGB	3/84
CHECKED	RC	3/84
APPROVED		

TITLE
GENERAL IMPOUNDMENT
DETAIL

REVISION NO

DRAWING NO
62



Appendix 16 (continued)

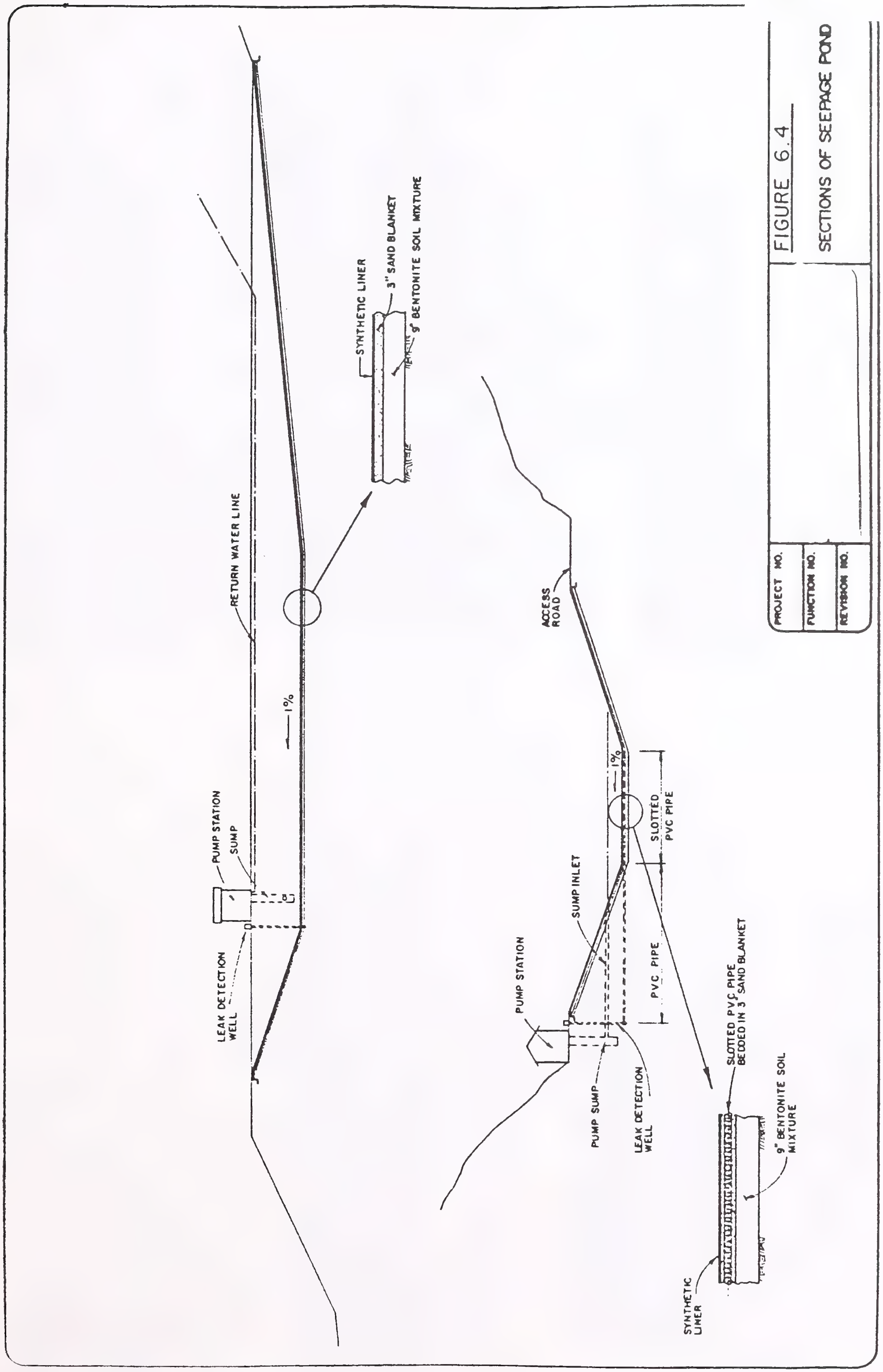


FIGURE 6.4

SECTIONS OF SEEPAGE POND

Appendix 17

P-8832-000

UNITED STATES OF AMERICA

FEDERAL ENERGY REGULATORY COMMISSION

Notice of Application Filed with the Commission

(August 8, 1985)

Take notice that the following hydroelectric application has been filed with the Federal Energy Regulatory Commission and is available for public inspection:

a. Type of Application: Preliminary Permit

b. Project No: 8832-000

c. Date Filed: December 26, 1984

d. Applicant: Enco Development Corporation

e. Name of Project: Bear Creek Power

f. Location: On Bear Creek, a tributary of the Yellowstone River, within the Gallatin National Forest lands, near Gardiner, in Park County, Montana.

g. Filed Pursuant to: Federal Power Act, 16 U.S.C., §§791(a)-825(r)

h. Contact Person: Mr. Kenneth R. Koch
Enco Development Corporation
P.O. Box 5663
Bellingham, Washington 98227

i. Comment Date: OCT 7 1985

j. Description of Project: The project would consist of: (1) an existing concrete diversion structure at elevation 6,320 feet; (2) an existing 10,400-foot-long open conveyance ditch; (3) a proposed 3,250-foot-long, 18-inch-diameter steel penstock; (4) a proposed powerhouse containing a single generating unit with an installed capacity of 400 kW; and (5) a 2-mile-long, 50-kV transmission line connecting to an existing Montana Power Company transmission line. The Applicant estimates an annual energy production of 2.5 million kWh.

A preliminary permit does not authorize construction. Applicant seeks issuance of a preliminary permit for a term of 24 months during which it would conduct engineering and environmental feasibility studies and prepare an FERC license application at a cost of $75,000. No new roads would be constructed or drilling conducted during the feasibility study.

k. Purpose of project: The project power would be sold to Montana Power Company.

l. This notice also consists of the following standard paragraphs: A5, A7, A9, B, C and D2.

A5. Preliminary Permit -- Anyone desiring to file a competing application for preliminary permit for a proposed project must submit the competing application itself, or a notice of intent to file such an application, to the Commission on or before the specified comment date for the particular application (see 18 CFR 4.36 (1985)). Submission of a timely notice of intent allows an interested person to file the competing preliminary permit application no later than 30 days after the specified comment date for the particular application.

A competing preliminary permit application must conform with 18 CFR 4.30(b)(1) and (9) and 4.36.

A7. Preliminary Permit -- Any qualified development applicant desiring to file a competing development application must submit to the Commission, on or before the specified comment date for the particular application, either a competing development application or a notice of intent to file such an application. Submission of a timely notice of intent to file a development application allows an interested person to file the competing application no later than 120 days after the specified comment date for the particular application.

A competing license application must conform with 18 CFR 4.30(b)(1) and (9) and 4.36.

A9. Notice of Intent -- A notice of intent must specify the exact name, business address, and telephone number of the prospective applicant, include an unequivocal statement of intent to submit, if such an application may be filed, either (1) a preliminary permit application or (2) a development application (specify which type of application), and be served on the applicant(s) named in this public notice.

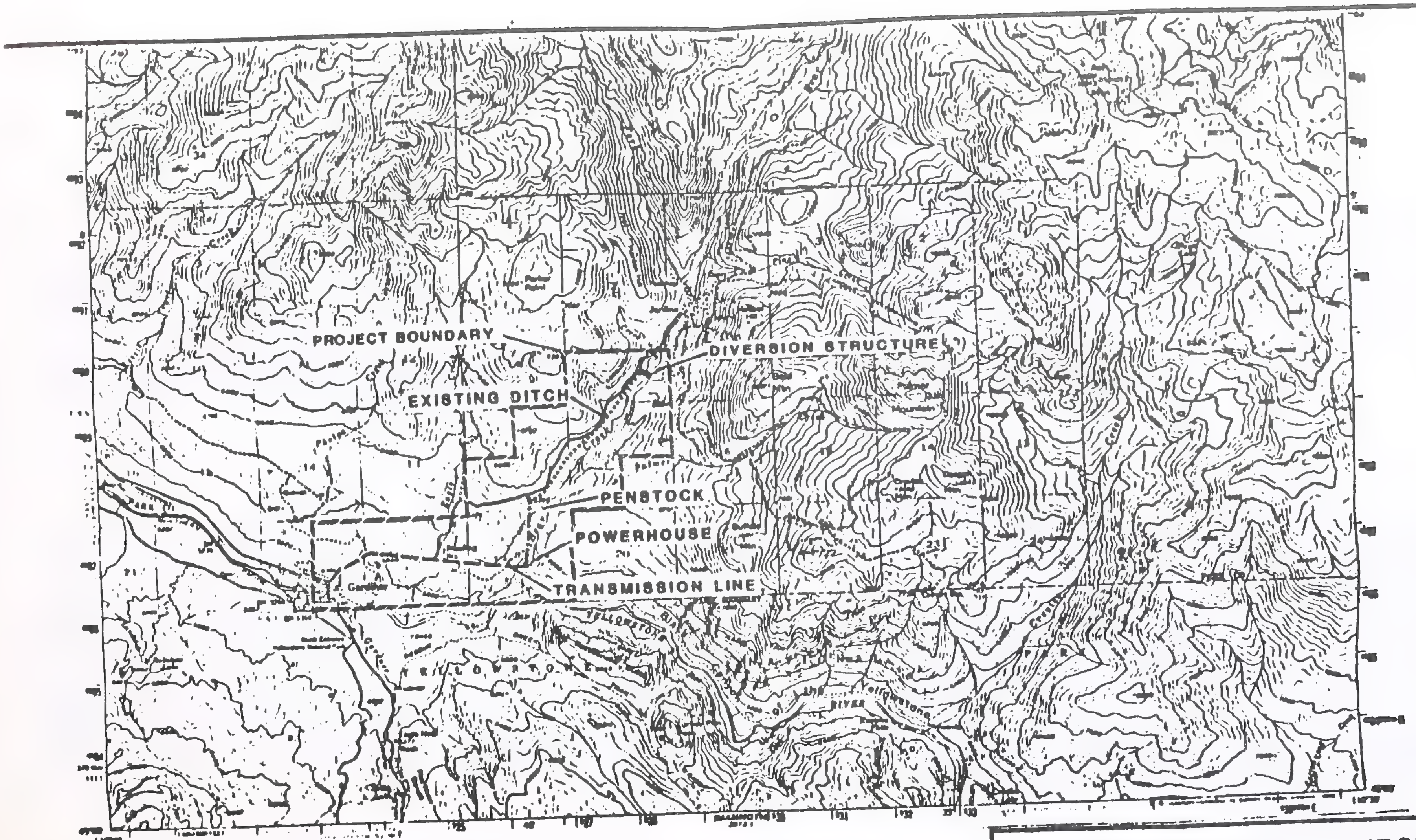
B. Comments, Protests, or Motions to Intervene - Anyone may submit comments, a protest, or a motion to intervene in accordance with the requirements of the Rules of Practice and Procedure, 18 C.F.R. §§385.210, .211, .214. In determining the appropriate action to take, the Commission will consider all protests or other comments filed, but only those who file a motion to intervene in accordance with the Commission's Rules may become a party to the proceeding. Any comments, protests, or motions to intervene must be received on or before the specified comment date for the particular application.

C. Filing and Service of Responsive Documents - Any filings must bear in all capital letters the title "COMMENTS", "NOTICE OF INTENT TO FILE COMPETING APPLICATION", "COMPETING APPLICATION", "PROTEST" or "MOTION TO INTERVENE", as applicable, and the Project Number of the particular application to which the filing is in response. Any of the above named documents must be filed by providing the original and the number of copies required by the Commission's regulations to: Kenneth F. Plumb, Secretary, Federal Energy Regulatory Commission, 825 North Capitol Street, N.E., Washington, D.C. 20426. An additional copy must be sent to: Mr. Fred E. Springer, Director, Division of Project Management, Federal Energy Regulatory Commission, Room 203-RB, at the above address. A copy of any notice of intent, competing application or motion to intervene must also be served upon each representative of the Applicant specified in the particular application.

D2. Agency Comments - Federal, State, and local agencies are invited to file comments on the described application. (A copy of the application may be obtained by agencies directly from the Applicant.) If an agency does not file comments within the time specified for filing comments, it will be presumed to have no comments. One copy of an agency's comments must also be sent to the Applicant's representatives.

Kenneth F. Plumb
Secretary

Appendix 17 (continued,


PROJECT BOUNDARY
DIVERSION STRUCTURE
EXISTING DITCH
PENSTOCK
POWERHOUSE
TRANSMISSION LINE
YELLOWSTONE RIVER
SCALE 1:62500
CONTOUR INTERVAL 80 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U S GEOLOGICAL SURVEY, DENVER, COLORADO 80225 OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

BEAR CREEK PROJECT-8832		
SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED
PROJECT LOCATION MAP		
ENCO Development Corp.		PLM-1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
CINCINNATI, OHIO 45268

DATE: April 1, 1980

SUBJECT: Memorandum of February 22, 1980 to Dr. Medz on Proposed Regulations

FROM: John F. Kopp, Chief John F. Kopp
Physical and Chemical Methods Branch

TO: Charles E. Stephan
Environmental Scientist
Environmental Research Laboratory - Duluth

Bob Booth has asked me to respond to your subject memorandum which you copied to him.

Let me begin by stating that numerous comments have been received as a result of the List of Approved Test Procedures published in the Federal Register of December 3, 1979 which referenced the 1974 edition of Methods for Chemical Analysis of Water and Wastes. A table referencing the 1979 edition has been prepared and hopefully will appear in the Federal Register in the near future.

Your reference to confusion over EPA's use of the word "total" metal goes back many years, but I was of the opinion that it had been generally accepted that "total" referred to the sum of the dissolved plus the suspended concentrations. You are correct in noting that a "less vigorous" digestion was recommended in the December 3, 1979, Federal Register for those samples where total constituents are to be determined. This is a carry-over from the Federal Register of Wednesday, December 1, 1976, and was based in part on information obtained in a joint EPA-ASTM study which compared the vigorous nitric acid digestion to a less vigorous nitric acid - hydrochloric acid treatment. Those results indicated that for the waste effluents investigated, both digestions produced comparable data. Additionally, there have been a number of alternate test requests to substitute the mild digestion for the vigorous digestion. These requests were accompanied by supporting data which demonstrated equivalency. A sediment round-robin, administered by the Southeast Water Laboratory, actually reported lower metal concentrations for certain sediments when the vigorous digestion was employed. Because of these data and the fact that the "less vigorous" digestion is less time consuming and thus preferred by the analyst, this option was and will continue to be recommended by EPA.

Occasionally, samples may be encountered where the less vigorous digestion does not suffice. Also, there is concern when an instrumental technique is not to be used in the analytical determination. The footnote which will address the problem in the revised table is as follows:

> For the determination of total metals the sample is not filtered before processing. A digestion procedure is required to solubilize suspended material and to destroy possible organic-metal complexes. Two digestion procedures are given in "Methods for Chemical Analysis of Water and Wastes, 1979." One (4.1.3), is a vigorous digestion procedure employing nitric acid. A less vigorous digestion using nitric and hydrochloric acids (4.1.4) is preferred; however, the analyst should be cautioned that this mild digestion may not suffice for all sample types. Particularly, if a colorimetric procedure is to be employed, it is necessary to ensure that all organo-metallic bonds be broken so that the metal is in a reactive state. In those situations, the vigorous digestion is to be preferred making certain that at no time does the sample go to dryness. Samples containing large amounts of organic materials would also benefit by this vigorous digestion. Use of the graphite furnace technique, as well as determinations for certain elements such as arsenic, the noble metals, mercury, selenium, and titanium require a modified digestion and in all cases the method write-up should be consulted for specific instructions and/or cautions.
>
> Dissolved metals are defined as those constituents which will pass through a 0.45 micron membrane filter. Following filtration of the sample, the referenced procedure for total metals must be followed. Sample digestion for dissolved metals may be omitted for AA (direct aspiration or graphite furnace) and ICP analyses provided the sample has a low COD and the filtrate meets the following criteria:
>
> a) is visibly transparent
> b) has no perceptable odor, and
> c) is free of particulate or suspended matter following acidification

On the subject of the STORET system, a block of 5 numbers was originally allocated to each metal of interest. Three of these numbers were immediately assigned to dissolved, suspended and total. This dates back to the National Water Quality Network days, before the NPDES came into being. Data to be entered into the STORET system under the "total" category was obtained on unfiltered samples that had undergone a vigorous digestion (repeated evaporations with nitric acid). For whatever reason, no new STORET numbers were ever assigned to the less vigorous digestion. Data obtained by this less vigorous digestion were to be referred to as total, although in actuality are called total recoverable. Also, if my memory serves me correctly, the biologists have pointed out on numerous occasions that EPA should be more concerned with recoverable metals than total metals because metals bound within the sediment particle probably would be non-reactive from a toxicity point of view.

Section 304(h) of the Federal Water Pollution Control Act Amendments requires the promulgation of guidelines establishing test procedures for the analysis of pollutants. The primary use of these approved methods is in conjunction with the National Pollutant Discharge Elimination System (NPDES). These permits most often require a total measurement and require reporting of data as total metal. Some also require measurement of and reporting as dissolved metals.

Finally, there is a need for several types of digestions. As you point out, the noble metals require an aqua regia treatment for solubilization. Arsenic, mercury, and selenium present problems because of their volatility. Silver can be particularly troublesome because of the insolubility of the chloride.

In conclusion, I agree with many of your statements. Unfortunately, many of the earlier decisions were made without some of the current knowledge.

cc: R. B. Medz, Senior Program Advisor, Monitoring Technology Division
Office of Monitoring and Technical Support
R. L. Booth, Deputy Director, Environmental Monitoring and Support
Laboratory

X-42 / Appendix 18

Office Memorandum •

STATE DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

TO : John Herrin, Dept. of State Lands **DATE:** June 12, 1984

FROM : Abe Horpestad

SUBJECT : Metal Analyses and Biological Significance

Types of metal analyses:

Dissolved = That portion which passes through a 0.45 u filter.

Suspended = That portion which will not pass through a 0.45 u filter. In practice this is very rarely done.

Total = Dissolved plus suspended, a complete digestion of an unfiltered sample would result in total metals. In practice, very few people attempt to measure total (ensuring that digestion is complete) metals. Instead they use one of the following procedures.

A "Hard" digestion procedure 4.1.3 in the EPA manual - this is usually referred to as "total" metals.

B "Soft" digestion procedure 4.1.4 in the EPA procedures manual. This is usually referred to as "total recoverable" but sometimes as "total". In many cases, it is not possible to determine whether this or the preceding "Hard" digestion is required or has been used.

C In addition many individual laboratories have their own procedures. In our case we have a total recoverable method which is an analyses of the supernatent from a sample which has been acidified in the field with 5 mls of HNO_3/l.

In our lab a total analyses is usually a "hard" digestion (except for As, Se and Hg which volatilize in the digestion).

The new source performance standards which must be used in our discharge permits give limitations in terms of pounds/ton of produce. These are in terms of total metals which apparently are determined using the "Soft" digestion! (see attached memo)

The biological significance of these various forms or fractions of the metals present is a matter of some dispute. It is usually accepted that dissolved metals are biologically significant. It is probable that at least some fractions of the suspended methods are biologically significant. However, there is limited agreement as to what this faction is and how to estimate it.

In the long term, we feel that "total recoverable" (soft digestion) metals may be of significance. For instance, some or all these metals probably can be solubilized under some natural conditions. We also feel that our total recoverable is of immediate biological significance; that is, it is a (we feel the best) measure of toxicity.

X-44 / Appendix 19

PRODUCING DEWATERED PRECIOUS-METAL TAILINGS

Prepared by
Steffen Robertson and Kirsten (Colorado) Inc,
7510 West Mississippi Avenue, Suite 210
Lakewood, Colorado 80226

October, 1984

1.0 INTRODUCTION

The production of dewatered or "dry" tailings has received serious consideration in the precious-metal industry in recent years. The production of tailings at a low moisture content in lieu of slurried tailings are considered where:

- Tailings impoundment sites are limited by size or topography and are, therefore, not amenable to slurried disposal;
- Seepage from a slurried tailings impoundment cannot be adequately or economically controlled;
- Stability of a slurried tailings impoundment during operation or in the years after reclamation is of major concern; and
- Licensing and permitting agency regulations or public opinion may not permit slurried disposal of tailings.

The dewatering techniques considered for precious-metal tailings have been used in other areas of the mining industry for several years. These techniques have been used to reduce the moisture content of a concentrate or waste, and clarify or optimize recycling of process water. Applications of dewatering techniques are:

- Dewatering of coal, coal refuse, and coal sludge (Green, 1981; Jacobsen et al., 1981; Fischer and Schill, 1981; Lynberg, 1981; Bradbury and Forster, 1980);
- Dewatering of uranium tailings (Frankfort, 1978; von Michaelis, 1979; Murray, 1979);
- Dewatering and preparation of gold tailings for mine backfill (Wayment, 1978); and
- Dewatering metal concentrates during processing.

2.0 DEWATERING TECHNIQUES

Various dewatering products and techniques that have been used in the applications listed above are summarized below:

2.1 Centrifuges

Several products use centrifugal forces caused by rotation to force solids away from liquids. These products are:

- Solid bowl centrifuge (Fig. 1). The solids are forced to the outside, up the narrowing portion of the centrifuge, and out the end of the centrifuge. Liquids are pushed out the opposite end of the centrifuge.

- Screen bowl centrifuge (Fig. 2). A screened section is located past the narrowing portion of the centrifuge to allow additional dewatering of the solids.

- Cyclone (Fig. 3). Entering slurry under pressure is forced to rotate inside the stationary cyclone. The larger particles are forced to the outside of the cyclone to the narrowing portion of the cyclone and out the underflow outlet. Liquids with fine particles of the solids remain in the center of the cyclone and under the applied pressure, exit out of the overflow outlet; and

- Tailspinner (Fig. 4). Entering slurry is forced to rotate inside the rotating tailspinner. In a manner similar to a cyclone, the solids are forced up the narrowing portion of the cyclone and out the underflow outlet, while liquids and lighter solids are pushed in the opposite direction and out the overflow outlet.

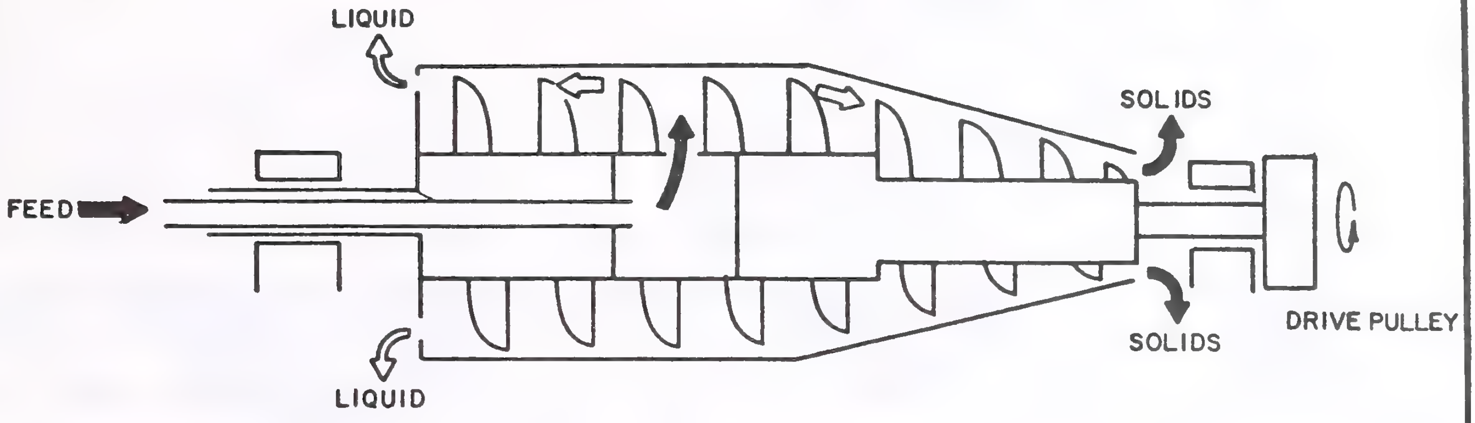


FIGURE 1. SOLID BOWL CENTRIFUGE

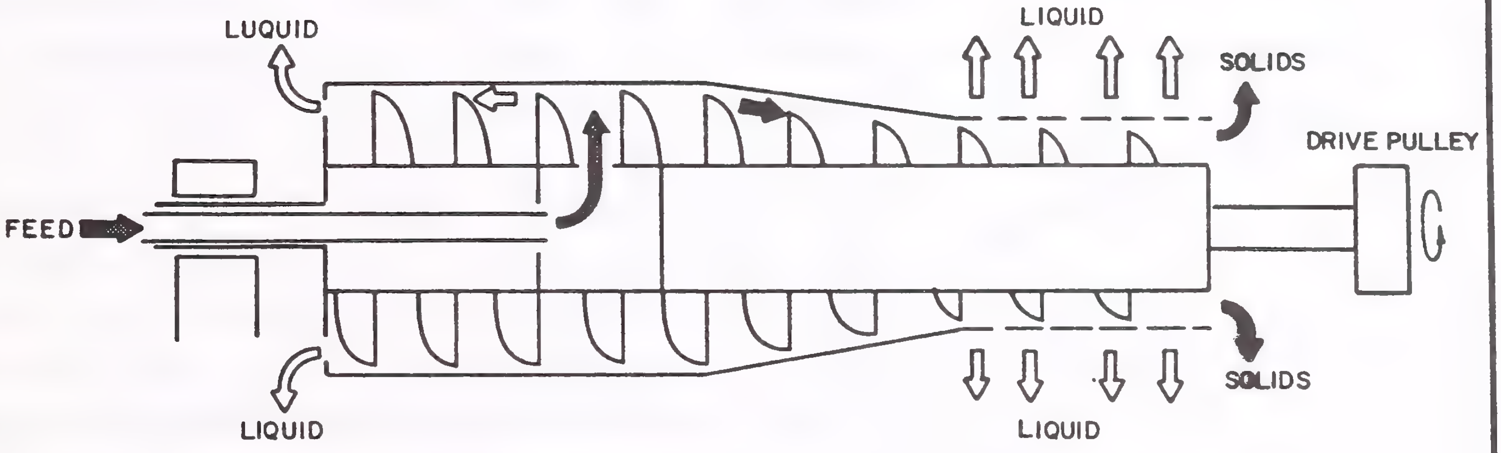


FIGURE 2. SCREEN BOWL CENTRIFUGE

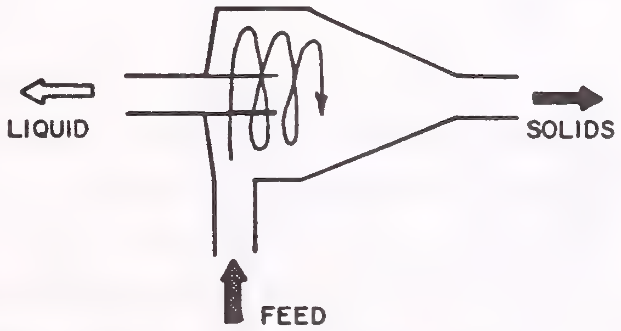


FIGURE 3. CYCLONE

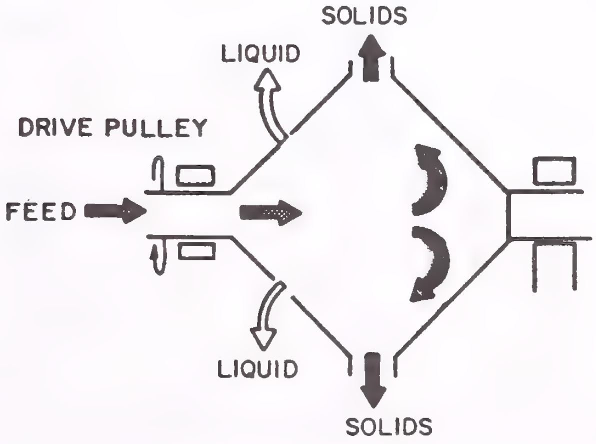


FIGURE 4. TAILSPINNER

PROJECT NO.
01921

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11/84

REVISION NO.
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PREPARED BY:
STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

TAILINGS DEWATERING METHODS

2.2 Filters

Several products use a pressure gradient across a filter to push or draw liquids away from solids. These products are:

- Drum filter (Fig. 5). A cylindrical-shaped filter is partially submerged in a tank of slurry. As the cylinder is rotated, the slurry is picked up on the filter. A vacuum inside the cylinder draws liquid from the slurry adhering to the filter. Before re-entering the slurry, a stripping device removes the dewatered solids from the filter.

- Disc filter (Fig. 6). The disc filter is similar to the drum filter, but with the cylindrical-shaped filter replaced by a series of disc-shaped filters. The disc filter is rotated through the slurry tank, with vacuum provided insided the discs. The filters are stripped of solids before re-entering the slurry. The disc filter provides more filtering surface area than a similarly sized drum filter.

- Vacuum belt filter (Fig. 7). Slurry is placed on a continuous belt-shaped filter. A vacuum is applied across a portion of the belt to dewater the solids.

- Belt filter press (Fig. 8). Slurry is placed between two continuous belt-shaped filters. The belts pass between rollers of increasing tightness and angles of curvature, squeezing liquids from the solids. At the end of the cycle, the belts are separated and the solids are removed.

- Pressure filter (Fig. 9). Slurry is placed in a filter-lined chamber and is squeezed to one side of the chamber under high pressure. After the pressure cycle, the

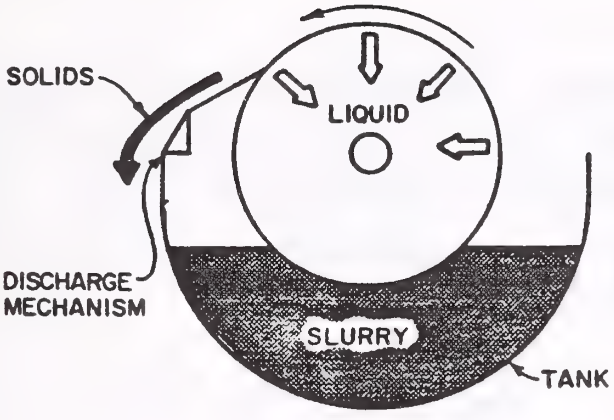


FIGURE 5. DRUM FILTER

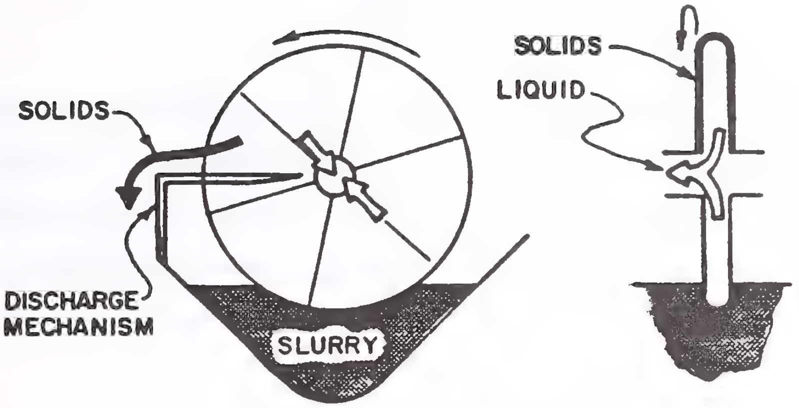


FIGURE 6. DISC FILTER

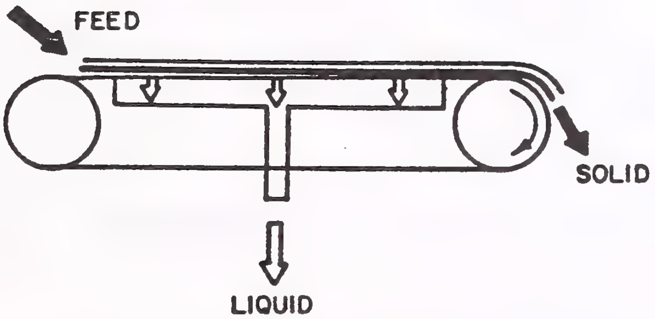


FIGURE 7. VACUUM BELT FILTER

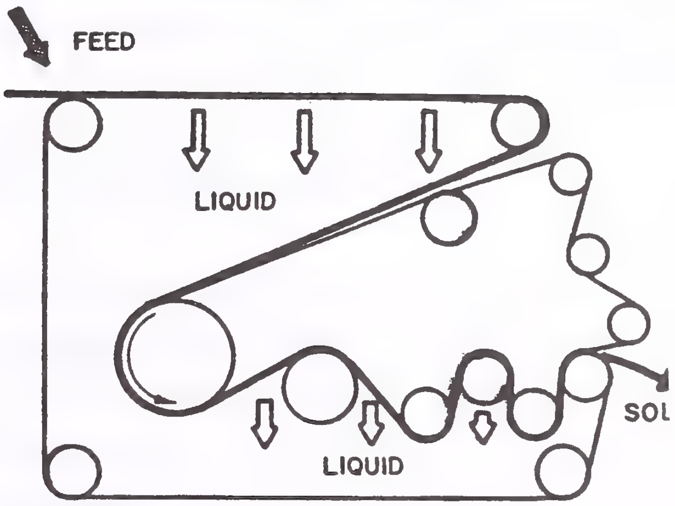
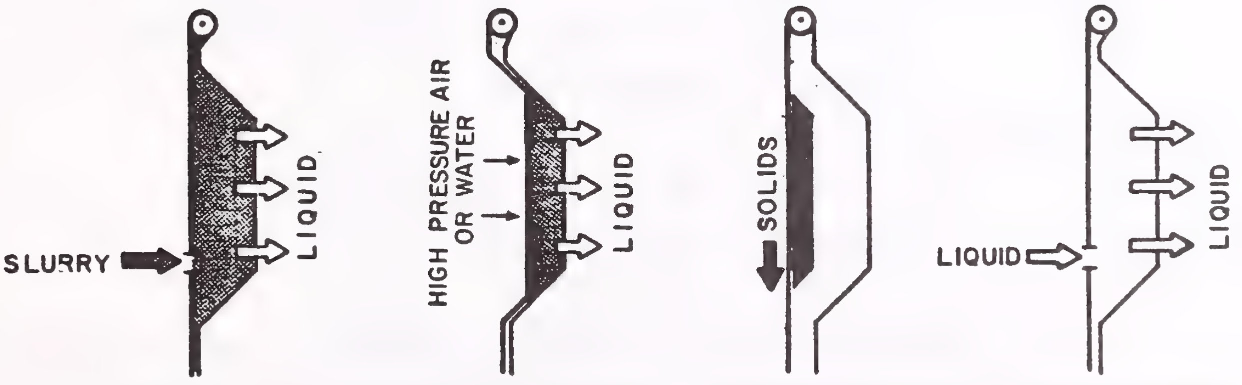


FIGURE 8. BELT FILTER PRESS



a. FILTRATION
b. DIAPHRAGM PRESSING
c. CAKE DISCHARGE
d. CLOTH WASHING

FIGURE 9. FILTER PRESS

PROJECT NO.
01921

DATE
11/84

REVISION NO.
0

PREPARED BY:
STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers

TAILINGS DEWATERING
METHODS

chamber is opened and the solids are removed. The pressure filter is not a continuously operating dewatering device, but operates in cycles. Pressure filters are usually designed with a number of chambers operating at the same time.

2.3 Driers

Driers are used occasionally in the coal industry, but are considered impractical for mine tailings.

3.0 EVALUATION OF DEWATERING

The consideration of a dewatering system for precious-metal tailings includes:

- Whether the tailings can be dewatered to the desired degree and at the anticipated production rates;
- If dewatering allows a better or more cost effective method of disposal (in terms of capital plus operating costs) than slurried disposal; and
- Which dewatering technique is best suited to the tailings and project requirements.

Important factors in this evaluation are the characteristics of the tailings, including particle-size distribution, water-holding capacity of the finer tailings particles, and chemistry of the tailings. These factors affect whether or not the tailings can be dewatered to the desired degree, what area of filter or size of centrifuge is required, and what the corrosion, abrasion, and other maintenance factors will be. Other factors include the process requirements, such as the rate of tailings production, the recovery process, and the desired moisture content of the dewatered tailings.

Several of these factors are summarized for the various dewatering techniques in Table 1. Significant variations in final moisture content, capital costs, and operating costs are shown. Data used in Table 1 came from papers listed in Section 6 and equipment manufacturers and dealers listed in Table 2.

4.0 EVALUATION EXAMPLE

An example of a particular tailings product and production rate is given to illustrate the evaluation factors and alternatives discussed in the previous sections. A gold tailings with the following characteristics and process requirements was considered:

- Grain size distribution:
    80% passing No. 200 sieve (0.074 mm),
    65% passing No. 400 sieve (0.037 mm),
    8% smaller than 20 microns (0.002 mm);
- Production rate: 1000 tpd (42 tph); and
- Final required moisture content: 15%.

Based upon the information in Table 1, the following techniques were eliminated:

- Solid bowl centrifuge - final moisture too high and very high wear of bowl;
- Screen bowl centrifuge - tailings too small for screen;
- Cyclone - final moisture too high;
- Tailspinner - final moisture too high;
- Drum filter - final moisture may be too high; and
- Vacuum belt filter - final moisture may be too high.

The remaining techniques were:

- Disc filter - medium capital cost, high operating cost;
- Belt filter press - high capital and operating costs; and
- Pressure filter - high capital and operating costs.

TABLE 1 EVALUATION OF DEWATERING TECHNIQUES FOR GOLD TAILINGS

EQUIPMENT/PROCESS	PRINCIPLE OF OPERATION	APPLICABLE PARTICLE SIZE[a]	FINAL MOISTURE CONTENT[b] (%)	CAPITAL COST[c]	OPERATING COST[c]	COMMENTS
Solid bowl centrifuge	Separation of liquid by rotation of centrifuge	Most sizes	25-50	High	Low	Very high bowl abrasion with gold tailings
Screen bowl centrifuge	Separation of liquid by rotation of centrifuge	Screen size (+100 mesh)	5-30	High	Low	Screen size too coarse for gold tailings
Cyclone	Separation of liquid by rotation of slurry	100 to 200 mesh	30-100	Low	Low	Separation of coarse fraction of tailings
Tailspinner	Separation of liquid by rotation of tailspinner	+2 microns	20-50	Low	Low	Preparation of tailings for mine backfill; small units
Drum filter	Suction of liquid by vacuum through filter	Filter size (+325 mesh)	20-50	Medium	High	
Disc filter	Suction of liquid by vacuum through filter		10-50	Medium	High	
Vacuum belt filter	Suction of liquid by vacuum through filter belt	Filter size	25-40	High	High	
Belt filter press	Separation of liquid by pressure between rollers	Filter size	15-40	High	High	Flocculants used to aid dewatering
Pressure filter	Separation of liquid by pressure between plates	Filter size	10-30	High	High	Batch dewatering process using a number of plates

[a] For general purposes; applicablity depends upon grain-size distribution and water-holding capacity of solids.

[b] Generalized values; actual values dependent upon grain-size distribution and water-holding capacity of solids, as well as production rate and characteristics of equipment.

[c] Relative values based upon 1000 tpd (42 tph) production rate.

TABLE 2 SOURCES OF EQUIPMENT DATA FOR EVALUATION

Manufacturer	Dealer	Name and Location
	X	Appcor, Denver, Co.
X		Arus-Andritz, Arlington, Tx.
X		Bird Machine Co., South Walpole, Ma.
X		Centrifugal and Mechanical Industries, St. Louis, Mo.
X	X	Denver Equipment Division, Denver, Co.
	X	D.W. Daigler Co., Denver, Co.
X		EIMCO Process Machinery Division, Salt Lake City, Ut.
X		Krebs Engineering, Menlo Park, Ca.
X		Humboldt Wedag USA, Atlanta, Ga.
X		Joy Manufacturing Co., Denver, Co.
X		Krauss-Maffei Corporation, Wichita, Ks.
X		Outokumpu Engineering, Inc., Denver, Co.
X		Parkson Corporation, Fort Lauderdale, Fl.
X		Schramm, Inc., Denver, Co.
X		Shriver/EIMCO Process Equipment Co., Salt Lake City, Ut.
	X	Ted Miller Associates, Inc., Denver, Co.
	X	Wemco, Inc., Sacramento, Ca.

For the remaining techniques, it is anticipated that three units would be used, with two operating and one on standby.

For this application, the disc filter appeared to be the most suitable of the three remaining techniques based upon the preliminary data given above. The disc filter met the process requirements and had the lowest capital cost. Detailed capital cost and operating cost estimates could not be made in this evaluation without tests conducted on a sample of the tailings.

The selection of a particular dewatering technique should be made from among the most suitable alternatives based upon testing of an actual sample of the tailings.

5.0 SUMMARY

Dewatering of mine tailings in the precious-metal industry has received increasing interest due to increasing costs and regulatory and environmental concerns associated with slurried tailings disposal. Techniques for dewatering fine-grained materials have been accepted and used in the coal, uranium, and metal processing industries, and are generally applicable to precious-metal tailings.

The selection of a particular dewatering technique and piece of equipment from among the variety of techniques and equipment available is dependent upon several project-specific factors, including the physical and chemical characteristics of the tailings, and the general process requirements.

6.0 REFERENCES

Green, Peter, "Dewatering Coal and Refuse" - an Equipment Guide, Coal Age, May, 1981.

Jacobsen, S.P., Roushey, W., Rau, E.L., "Coal Waste Dewatering Systems" Minerals and Research Contract J020512 Report. Feb. 1981.

Frankfort, J. Harry, "A Milling Process Providing Flexibility to Tailings Disposal Methods", Symp. on Uranium Mill Tailings Management, Fort Collins, Nov. 1978.

von Michaelis, Hans, "Belt Filtration for Uranium Mills", Symp. on Uranium Mill Tailings Management, Fort Collins, Nov. 1979.

Murray, David J., "The Use of Belt Filters in the Uranium Industry", Symp. on Uranium Mill Tailings Management, Fort Collins, Nov. 1979.

Fischer, M.C. and Schill, M.G., "The Dewatering of Fine Coal Refuse With a Continuous High Performance Belt Filter Press". Mining Engineering, Oct. 1981.

Lynberg, T.M., "Use of Double Filter Press at Centralia, Washington," May, 1981, Coal Show.

Bradbury, R. and Forster, H.W., "Refuse Sludge Dewatering at Martin County Coal Corporation, Inez, Kentucky", Kentucky Mining Institute, Lexington, Kentucky, Nov. 1980.

Wayment, William R., "Backfilling with Tailings - A New Approach", Mining with Backfill, "12th Canadian Rock Mechanics Symposium", Sudbury, 1978.

X-56 / Appendix 20

AMERICAN COOPER & NICKEL COMPANY, INC.
4860 Robb Street
Wheat Ridge, Colorado 80033
(303) 425-1230

November 18, 1985

Steve Pilcher
Bureau Chief
State of Montana
Department of Health and Environmental Sciences
Water Quality Bureau
A 206 Cogswell Building
Helena, MT 59620

Re: Jardine Joint Venture Project MPDES Permit Application

Dear Mr. Pilcher:

Enclosed please find a Montana Pollutant Discharge Elimination System (MPDES) Permit Application, for the proposed Jardine Joint Venture Project. The Application is being submitted pursuant to ARM 69-4823.

If you have any questions, please feel free to contact me.

Sincerely,

Joy Moseley for

R. T. Agar
Vice President
Manager

FOR AGENCY USE ONLY

Application Number
M T
Date Received
Month / Day / Year

MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM APPLICATION TO DISCHARGE FROM A PLACER MINING OPERATION - SHORT FORM P

RETURN TO: Water Quality Bureau - A206 Cogswell Building
Dept. of Health & Environmental Sciences
State of Montana
Helena MT 59620

Please Print or Type

1. Name, address, location and telephone number of the individual or company which do the mining and have responsibility for any discharge(s):

A. Name Jardine Joint Venture -American Copper And Nickel Company, Inc.

B. Mailing address

(1) Street address 4860 Robb Street

(2) City Wheat Ridge (3) State Colorado

(4) Zip 80033 (5) Telephone number (303) 425-1230

2. Give the exact location of the mining activity.

A. Quarter SW B. Section 9 C. Township 9S

D. Range 9E E. County Park

3. Describe the method of wastewater treatment which will be used.

A. Complete retention pond with no discharge . . . . ☐
B. Land application with no discharge. . . . . ☐
C. Settling pond with a discharge. . . . . ☒
D. No treatment (direct discharge) . . . . ☐
E. Other (description) Pond will only discharge occassionally, see narrative.

4. What is the name of the stream or water which will receive the discharge?

Bear Creek

5. How many separate discharge points? 7

6. The discharge is expected to begin on or about May (Month) 1 (Day) 198 (Ye

7. What is the water pumping capacity of your suction dredge or gravel washing equi

_______________ gallons per minute. NA

8. If using a suction dredge, what is the diameter of your suction hose? _______

9. Proposed maximum amount of gravel to be washed.

(1) ___________ cubic yards per day.
(2) ___________ cubic yards per year.

10. General Information.

Provide a sketch map and brief description of your proposed mining activity.

A narrative describing the activities and a map showing the location of discharge points is attached.

I certify under penalty of law that I have personally examined and am familiar with th information submitted in the attached document; and based on my inquiry of those indiv immediately responsible for obtaining the information, I believe the submitted informa is true, accurate and complete. I am aware that there are significant penalties for s mitting false information, including the possibility of fine and imprisonment.

R. T. Agar
Printed Name of Person Signing

Vice President-Manager
Title AMERICAN COPPER & NICKEL CO.,INC.

November 14, 1985
Date Application Signed

Signature of Applicant

Subsection (6) of Section 69-4823 provides that any person who knowingly makes a false statement, representation, or certification on this application shall upon conviction subject to a fine of not more than $10,000 or by imprisonment for not more than six (months, or both.

Surface water impoundments and potential discharges

The Jardine Joint Venture is proposing an underground precious metals mine near Jardine, Montana (see Figure 1). Mining access will be at five (5) adits into Mineral Hill. The locations of these adits are shown on Exhibit 1. A facilities area including ore crushers, mill, packing areas, maintenance buildings, office and associated roads is also shown on Exhibit 1. A gravel pit and crusher and a tailings impoundment area are planned to the Southwest of the facilities area.

The runoff from all disturbed areas is collected by ditches and detained in settling ponds. These ponds are designed to retain the anticipated volume of runoff from a 10 year 24 hour storm. Spillways are provided to safely convey the anticipated discharge through the ponds from a 100 year 24 hour event. The ponds will be dewatered by evaporation and seepage. Each pond is designed large enough to allow accumulation of sediment in addition to the water storage.

Locations of disturbances, settling ponds and potential points of discharge are shown on Exhibit 1.

Impoundments

In areas where overland flow is of primary concern, the SCS method of estimating runoff from precipitation events (SCS, 1977) is being used. The method provides estimates of peak discharge and volume of flow from the design event and is adaptable for use on small areas. This method is used in sizing sediment collection ditches and ponds around disturbed areas, topsoil piles and waste rock storage areas.

Selection of vegetative cover conditions is made based upon revegetation of all disturbances that can practically be seeded. Roads, parking areas, etc. are considered barren. Design parameters for each site are included in the individual site calculations (attached).

The general plan of surface water control is based upon diversion of upgrade runoff away from disturbances and collection of all runoff from disturbed areas in settling and evaporation/seepage ponds. The ponds are sized to retain the runoff from a 25 year-24 hour event and have spillways designed for a 100 year event. Since all ponds are quite small, detailed flood routing through the reservoir was not considered practical. The ponds are planned to remain in place and be maintained until reclamation has progressed to the point they are no longer needed.

Each pond is designed with enough surface area to provide for seepage of all impounded waters out of the pond within seven days. Seepage rates are based on soils information and decreased by at least 50 percent to account for reduction of seepage due to sediment buildup. This method of disposal was selected as a conservative basis for pond sizing. During evaluation prior to pond construction it may be feasible to install a decant system.

Appendix 20 / X-61

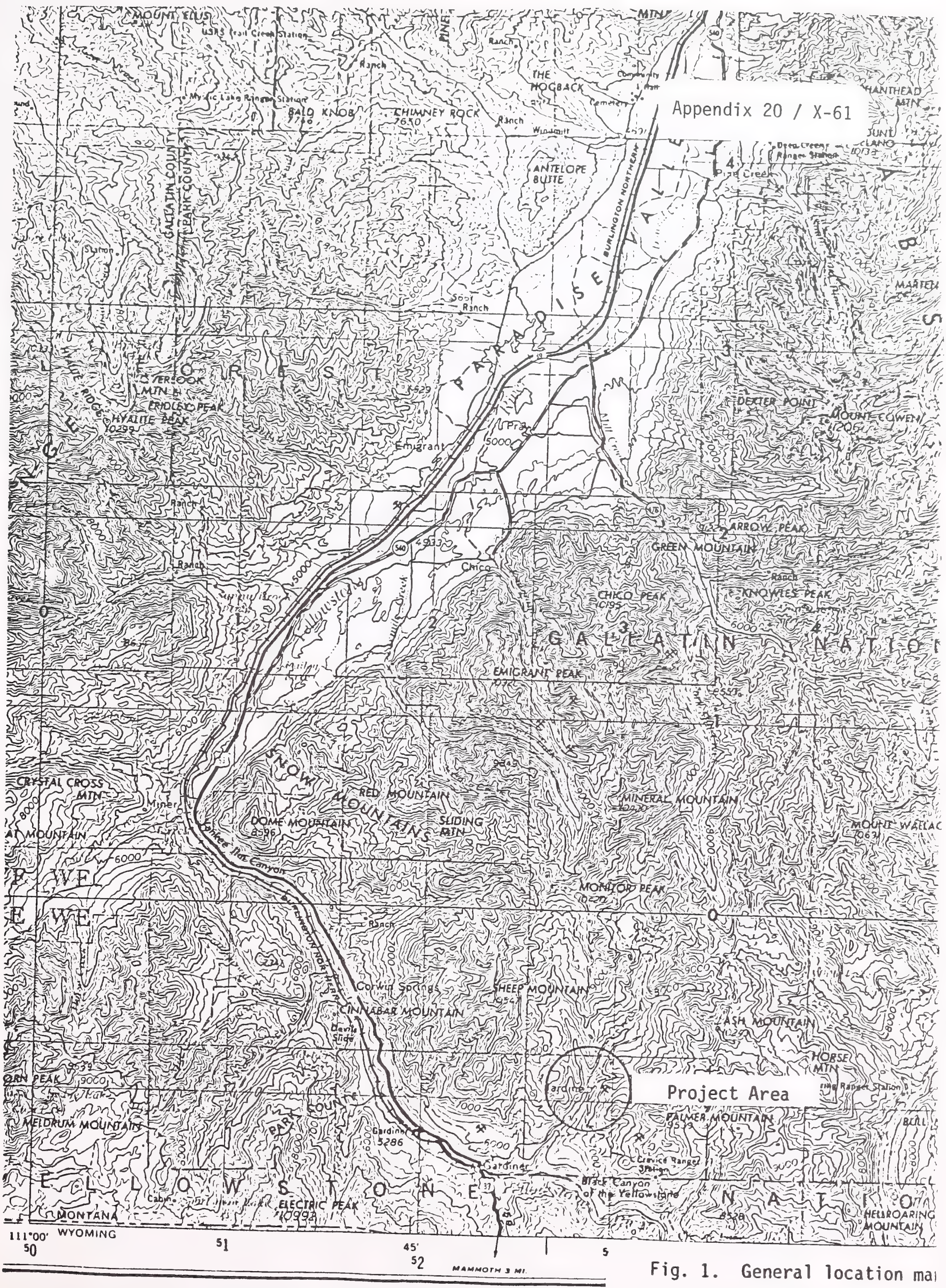


Fig. 1. General location ma

Ponds will be inspected in the spring and fall and cleaned when sediment accumulation exceeds 12 inches on the pond bottom. The removed sediment will be deposited adjacent to the pond, revegetated and used for ultimate pond backfilling.

Ditches will be inspected annually and erosion and bank damage repaired as necessary. Steep ditches will be rip-rapped as described in each site plan.

Design calculations, ditch requirements and pond sizes are included in the attached calculations. Table 1 summarizes the sediment control criteria and dimensions of structures. Figures 2 and 3 are typical cross-sections of ponds and diversion and collection ditches.

Site evaluations prior to final pond construction will include evaluation of slope and pond embankment stability and the feasibility of a decant system for removal of impounded water.

Figure 4 describes the emergency spillway details.

Runoff control for the gravel pit and wash plant site will be accomplished by grading the pit to drain to an interior corner. Water will be dissipated by seepage into the gravels.

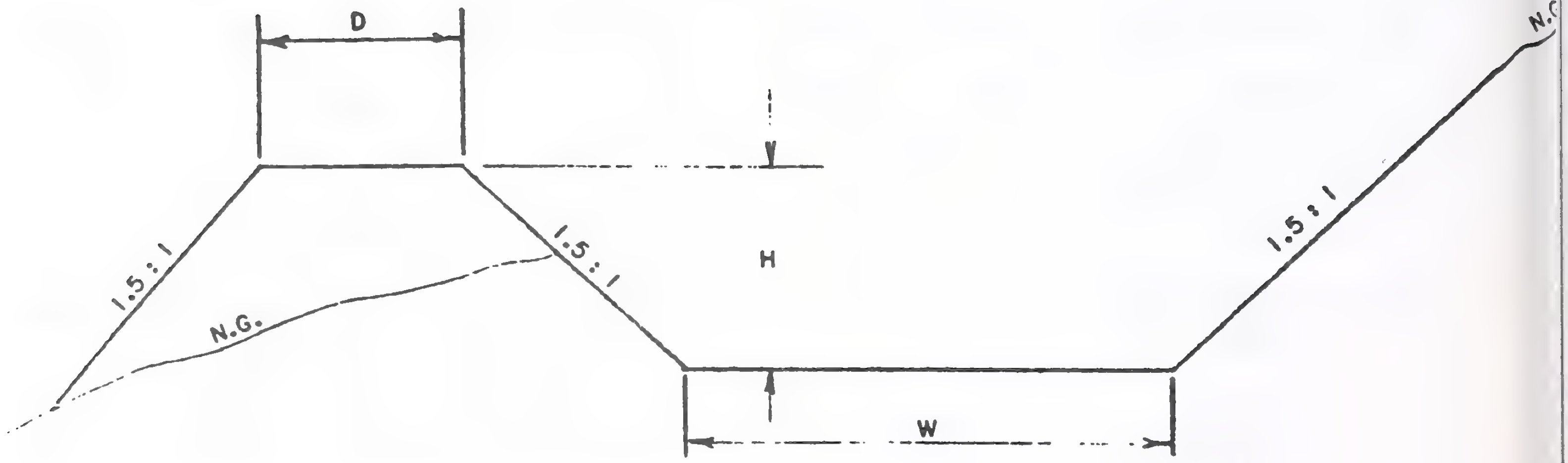
Table 1. Runoff volumes for sediment pond and spillway sizing.

Site Designation	Area Site (Ac)	R.O. Ac-ft	10 year discharge cfs	d* ft	w* ft	l* ft	Discharge Pt.No.
450	2.1	0.14	1	4	10	95	001
600	2.0	0.13	1	4	10	88	002
750	2.1	0.14	1	4	10	95	003
900	1.4	.09	0.6	4	10	61	004
Ore & topsoil stockpile-facilities area	5.7	.03	2.75	3	10	30	005
Facilities area	17.5	0.26	1.5	4	20	100	006
Topsoil storage-Tailings area	4.6	0.27	2.2	4	20	115	007

*Pond dimensions for Fig. 2.

Notes: Spillways all constructed in accordance with Fig. 4.

Diversions and collection ditches constructed in accordance with Fig. 3.



TYPICAL POND CROSS SECTION

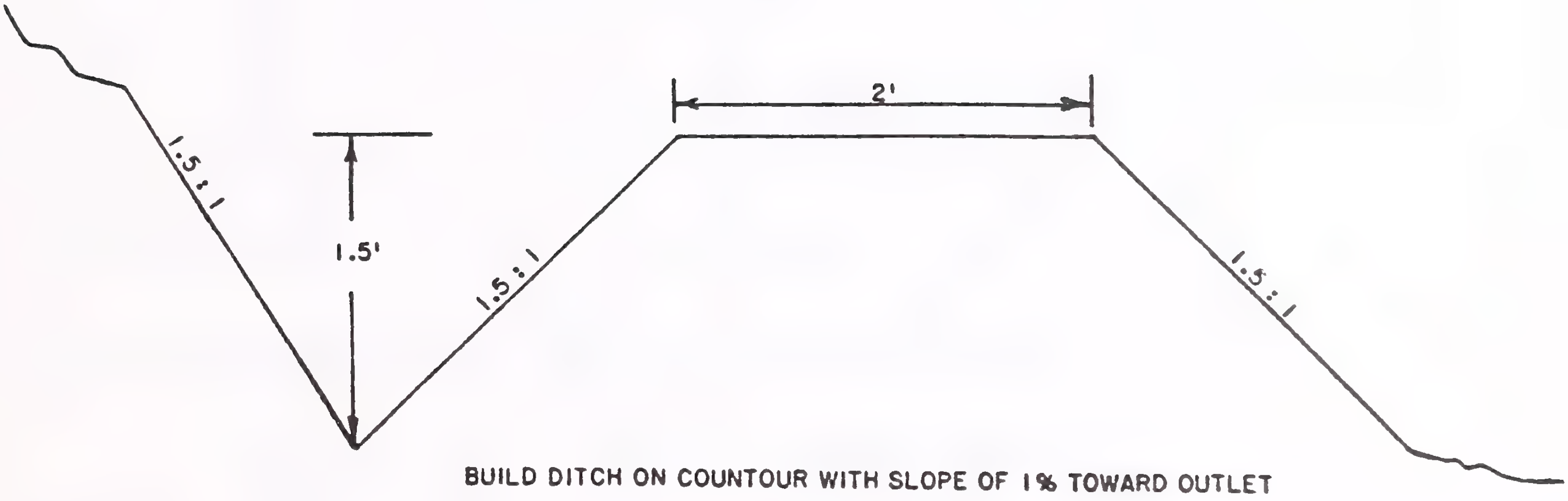
D DIKE TOP WIDTH $\frac{H}{5}$ IS MINIMUM

H POND DEPTH AS DESCRIBED IN SITE PLAN + 1 FT.

W POND BOTTOM WIDTH AS DESCRIBED IN SITE PLAN

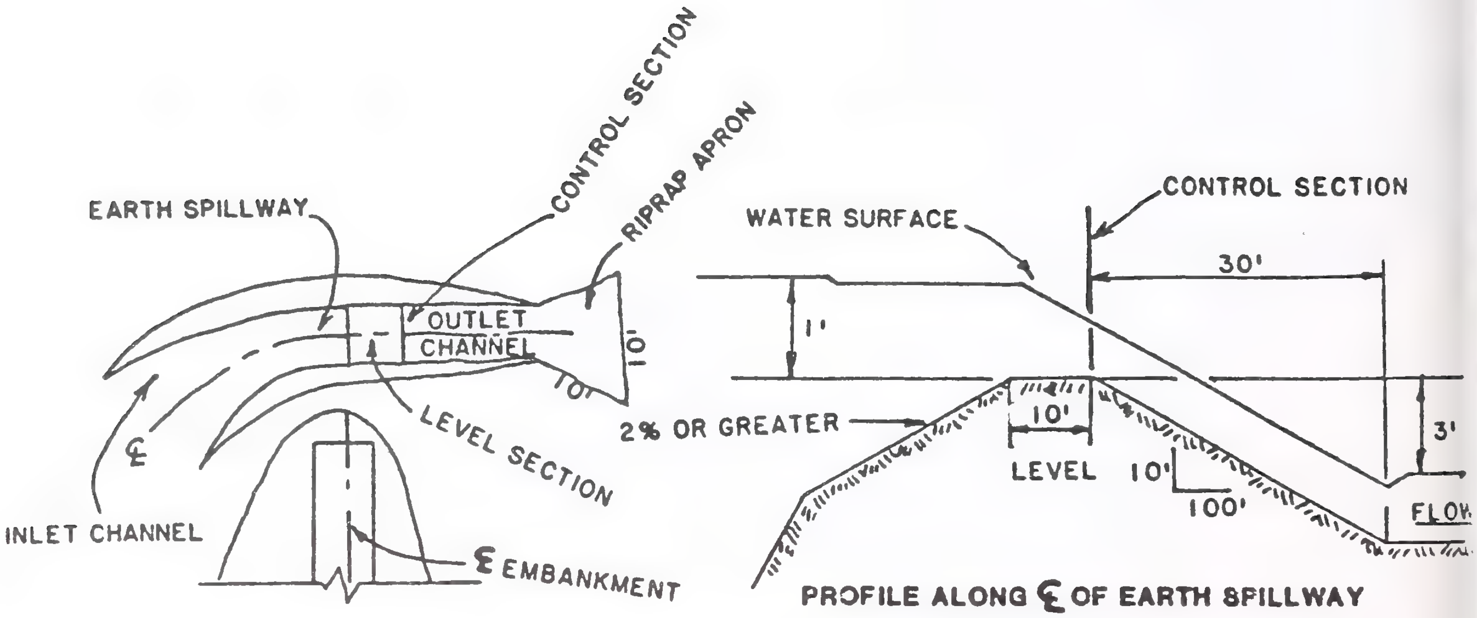
ALL SLOPES SHOWN ARE MAXIMUM, FLATTER SLOPES
ARE PREFERRED WHERE TOPOGRAPHY WILL ALLOW

FIGURE 2



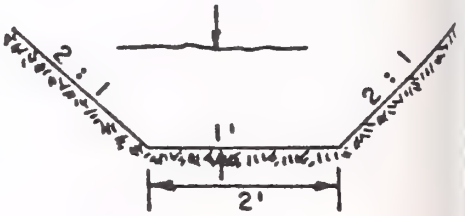
DIVERSION AND COLLECTION DITCH TYPICAL CROSS SECTION

FIGURE 3



PROFILE ALONG ℄ OF EARTH SPILLWAY

PLAN OF EARTH SPILLWAY



CROSS SECTION OF EARTH
SPILLWAY AT CONTROL SECTI

SPILLWAY DETAILS

FIGURE 4

Appendix 1. Surface water runoff calculations.

Runoff calculations for disturbed sites

Runoff calculated by SCS method from Engineering Field Manual, Chapter 2, Supplement 1, "Estimating Runoff in Montana", 1977.

Due to the very small size of the areas being evaluated a runoff calculation was done for the overall area in the vicinity of the portals (61 acres) (see Area I calculations). The runoff from the small disturbances within this area will be assumed to be a percentage of the runoff from the total area.

The basis for runoff calculations are:

Undisturbed ground CN = 44
100 year peak discharge from 61 acre = 0.1 cfs

Disturbed ground CN = 77
25 year runoff quantity 0.8 inch per acre
100 year peak discharge = 29.5 cfs

(see attached calculations)

Assumptions

Soil permeability is rapid at bottom of pond. Range is 2-6 inch/hour.

To account for sediment build up use 0.5 inch/hour.

Area 1

(Above Bear Creek Road)

Acres	Use	Hydrologic Group	CN
60.8	Forestland-grass	A-Fair	44
60.8	Disturbed	A-	77

Design Precipitation

25 year event P_{24} - 2.6 inches
P_6 - 1.6 inches
Ratio - .615

Runoff

CN=44 CN=77

$$\frac{(2.6 + 2 - \frac{200}{44})^2}{(2.6 - 8 + \frac{800}{44})} = .004 \text{ in.} \qquad \text{RO} \qquad .8 \text{ in.}$$

.004 x 60.8 Ac. 12 = 0.02 Ac.Ft.

Peak Discharge

CN=77
Ti=0.3 hr.

$$\frac{200}{77} - 2 \quad 2.6 = .23$$

or q.=244

Time of Concentration

$$\frac{[1720^{.8}][(\frac{1000}{44} - 10 + 1)^{.7}]}{1140\ (50)^{.5}} = 0.3 \text{ Hours}$$

Method Used: SCS Engineering Field Manual, 1977.

Area 1

Design Precipitation

100 year event

P_{24} - 3.0
P_6 - 2.0
Ratio - .667

Runoff

CN=44 CN=77

$$\frac{(3.0 + 2 - \frac{200}{44})^2}{(3.0 - 8 + \frac{800}{44})} = \frac{.21}{13.2} = 0.016 \text{ inches} \quad 1.0$$

0.016 x 60.8 12 = 0.08 Ac.Ft. = 5.42 Ac.Ft.

Peak Discharge

CN=44 CN=77

$\frac{200}{44} - 2$ 3.0 = .85 or q = 66 .20 or q = 290

$\frac{65 \times 60.8 \times .016}{640} = 0.1$ cfs. $\frac{290 \times 60.8 \times 1.07}{640} = 29.47$ cfs

Time of Concentration

From EX 2.1-4 Tc = 0.14 hr.

Site: 450 level

Area above portal requiring runoff diversion 6.5 acres.

Peak 100 year discharge $\frac{6.5}{61}(0.1) = .01$ cfs

Disturbed area 2.1 acres

Runoff volume (for pond)

0.8 x 2.1   12   0.14 Ac.Ft.

100 year peak discharge $= \frac{2.1(29.5)}{61} = 1$ cfs.

Diversion ditch dimensions -

In accordance with typical cross section

Collection ditch dimensions (same as diversion)

Pond dimensions

For volume

$W = 10$ $z = 1.5:1$

$d = 4$

Crosssectional area

$A = (10(4) + 1.5(4)^2) = 64$ ft.^{2}

$L = \frac{(.14 \times 43560)}{64} = 95$ ft

or 100 ft. is no upgrade diversion planned.

For seepage.   Permeability 0.5 in/hr.

Bottom area 10 x 95 = 950 ft.^{2}

will seep at 40 c.f per hr.

Time to seep away 0.14 ac.ft. = 152 hrs. adequate

Spillway - Flow is very small. From USDA Agriculture Handbook No. 387, Table 4.

a spillway 1 ft. wide will carry 3.9 cfs. at 1.5 ft. of head. For ease of construction a spillway 2 ft wide and allowance for 1 ft. of head will be adequate.

Site 600 level

Area upgrade to be diverted.

7 acres.

Peak Discharge $\frac{7}{61}(0.1) = 0.1$ cfs

Volume to add to pond if no diversion planned

7 x .016 12 = .009 Ac.ft.

Pond Volume

Disturbed area = 2.0 acres

Volume 0.8 x 2 12 = .13 Ac.Ft.

100 year peak discharge

$\frac{2.0}{61}(29.5) = 1$ cfs

Crosssectional area:

W = 10'

d = 4' z - 1.5:1

$A = (10)(4) + 1.5(4)^2 = 64$ ft.^{2}

$L = \frac{(.13)(43560)}{64} = 88$ ft.

Spillway requirement: same size as 450 level.

Diversion above disturbance: in accordance with typical section

Collection ditch -
construct IAW typical section

750 level

Disturbed area = 2.1

Area about to be diverted - 10 acres±

Peak discharge for diversion $\frac{10}{61}$ (0.1) = 0.16 cfs

Required pond volume

0.8 x 2.1   12 = .14 Ac.Ft.

Spillway discharge

$\frac{2.1}{61}$ (29.5) = 1.0 cfs

Pond Dimensions

d = 4 ft.   z = 1.5:1

w = 10 ft (see 450 level coles)

L = 95 ft.

Spillway: IAW typical drawing

Diversion: IAW typical drawing

Collection: IAW typical drawing

900 level

Disturbed area

450 x 125 = 1.3 ac.

area about to be diverted - 1.5 acres

Required pond volume:

0.8 x 1.3   12 = 0.9 Ac.Ft.

Spillway discharge -

$\frac{1.3}{61}$ (29.5) = 0.6 cfs.

Pond Dimensions:

d = 4'   z = 1.5:1

w - 10'

A = 10'(4)' + 1.5(4)^2 = 64 ft.^{2}

L = $\frac{(.09)(43560)}{64}$ = 61 ft.

Spillway: IAW typical drawing

Diversion: IAW typical drawing

Collection ditch: IAW typical drawing

Ore stockpile and facilities topsoil stockpile area. This is in Area II, R.O = 0.7 in.

Disturbed area 5.7 Ac.

Area above to be diverted 9.2 acres.

Diversion flows $\frac{9.2}{61}$ (0.1) = 0.15 cfs.

Required pond volume

$\frac{(0.07095.7)}{12}$ = 0.3 Ac.Ft.

Spillway discharge $\frac{5.7}{61}$(29.5) = 2.75 crs.

Pond Dimensions

$d = 4$ ft. $z = 2:1$

$w = 20$ ft.

$A = (20)(4) + 2(4)^2 = 112$

$$L = \frac{(.26)(43560)}{112} = 101 \text{ ft}$$

Spillway: IAW typical drawing

Diversion and Collection: IAW typical drawing

Topsoil stockpile for soils from tailings area.

For topsoil volumes see "Topsoil Salvage" in Reclamation Plan (Vol. III of Jardine Joint Venture Operating Permit Application, March, 1984.)

Disturbed area - 4.6 ac.

R.O. Volume

$$\frac{0.7 \text{ in})(4.6)}{12} = 0.27 \text{ Ac.Ft.}$$

Spillway discharge = $\frac{4.6}{61}(29.5) = 2.2$ cfs.

Pond Dimensions

$d = 4$ ft. $z = 1.5$

$w = 20$ ft

$A = (4)(2) \times 1.5(4)^2 = 104 \text{ ft.}^2$

$$L = \frac{(0.27)(43560)}{104} = 113 \text{ ft. use } 115$$

Spillway: IAW typical drawing

Diversion and Collection: IAW typical drawing

Pond Dimensions

$d = 3$ ft. $z = 1.5:1$

$w = 10$ ft.

$A = (10)(3) + 1.5(3)^2 = 43.5$ ft.^{2}

$$L = \frac{(0.03)(43560)}{43.5} = 30 \text{ ft}$$

Spillway: IAW typical drawing

Diversion and Collection: IAW typical drawing

Facilities Area

Area II

Acres	Use	Hydrologic Group	CN	Avg.
17.5	Barren (60%)	A	77	58.2
	Meadow (Good) (40%)	A	30	

Design Precipitation

25 year event

P_{24} - 2.6
P_6 - 1.6
Ration - .615

Runoff

$$\frac{\left(2.6 + 2 - \frac{200}{58.2}\right)^2}{\left(2.6 - 8 + \frac{800}{58.2}\right.} = 0.16 \text{ inches R.O.}$$

.16 x 17.5   12 = 0.23 Ac.Ft.

Peak Discharge

$\frac{200}{58.2} - 2$ 2.6 = .55 or q = 63
)

$\frac{63 \times 17.5 \times .16}{640} = .27$ cfs

Time of Concentration

$$\frac{[1530^{.8}]\left[\left(\frac{1000}{58.2} - 10 + 1\right)^{.7}\right]}{1140\ (33^{.5})} = 0.25 \text{ hours}$$

Method used: SCS Engineering Field Manual, 1977.

Area II

Design Precipitation

100 year event

P_{24} - 3.0
P_6 - 2.0
Ratio - .667

Runoff

$$\frac{(3.0 + 2 - \frac{200}{58.2})^2}{(3.0 - 8 + \frac{800}{58.2})} = \frac{1.56}{8.74} = .18 \text{ inches R.O.}$$

$.18 \times 17.5 \quad 12 = .26$ Ac.Ft.

Peak Discharge

$\frac{200}{58.2} - 2 \quad 3.0 = .48$ or $q = 310$

$\frac{310 \times 17.5 \times .18}{640} = 1.5$ cfs

Time of Concentration

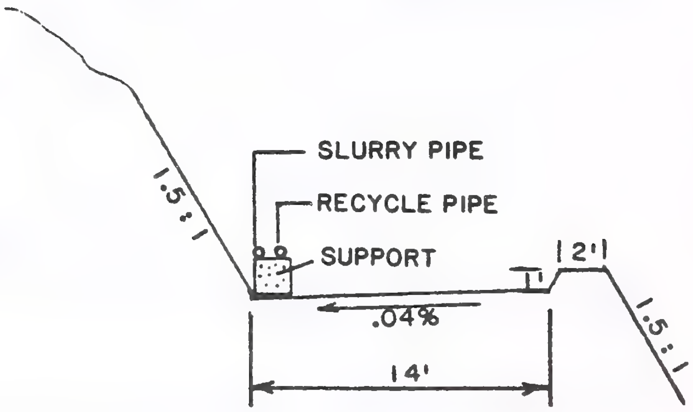
$$\frac{[1530^{.8}][\frac{1000}{58.2} - 10 - 1)^{.7}]}{1140\ (33^{.5})} = \frac{352.98 \times 4.35}{6548.8} = 0.25 \text{ hrs.}$$

Facilities Area

Pond Volume required = 0.23 Ac.Ft.

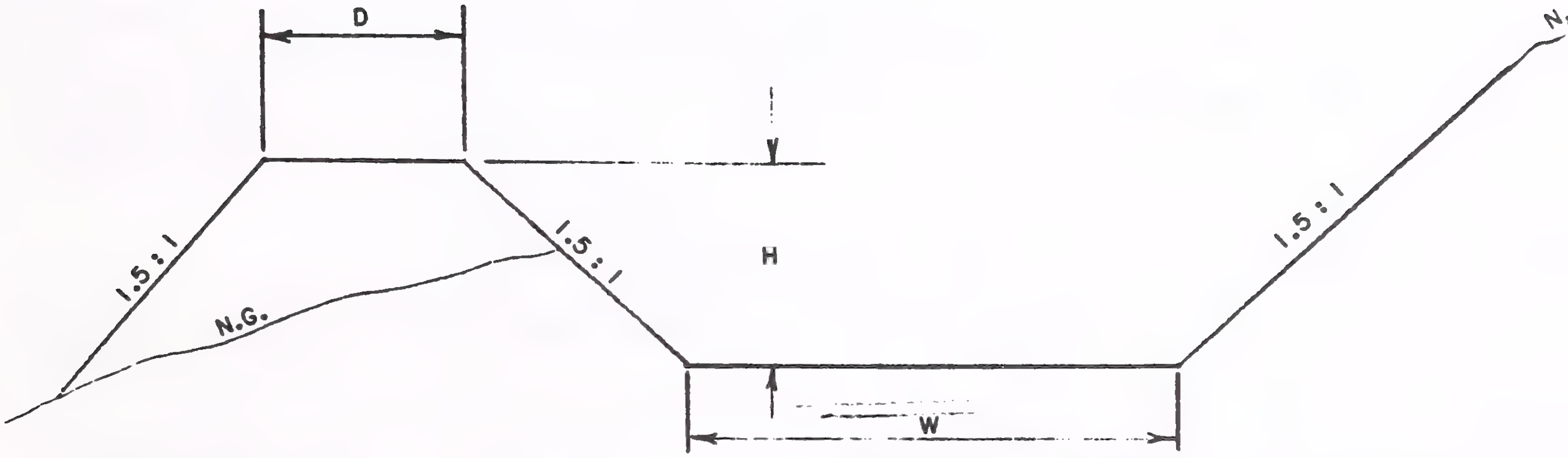
Due to proximity to Bear Creek design, pond to contain 100 year runoff of 0.26 Ac.Ft.

100 year discharge = 1.5 cfs.



TAILINGS LINE CROSS SECTION

FIGURE II-4



TYPICAL POND CROSS SECTION

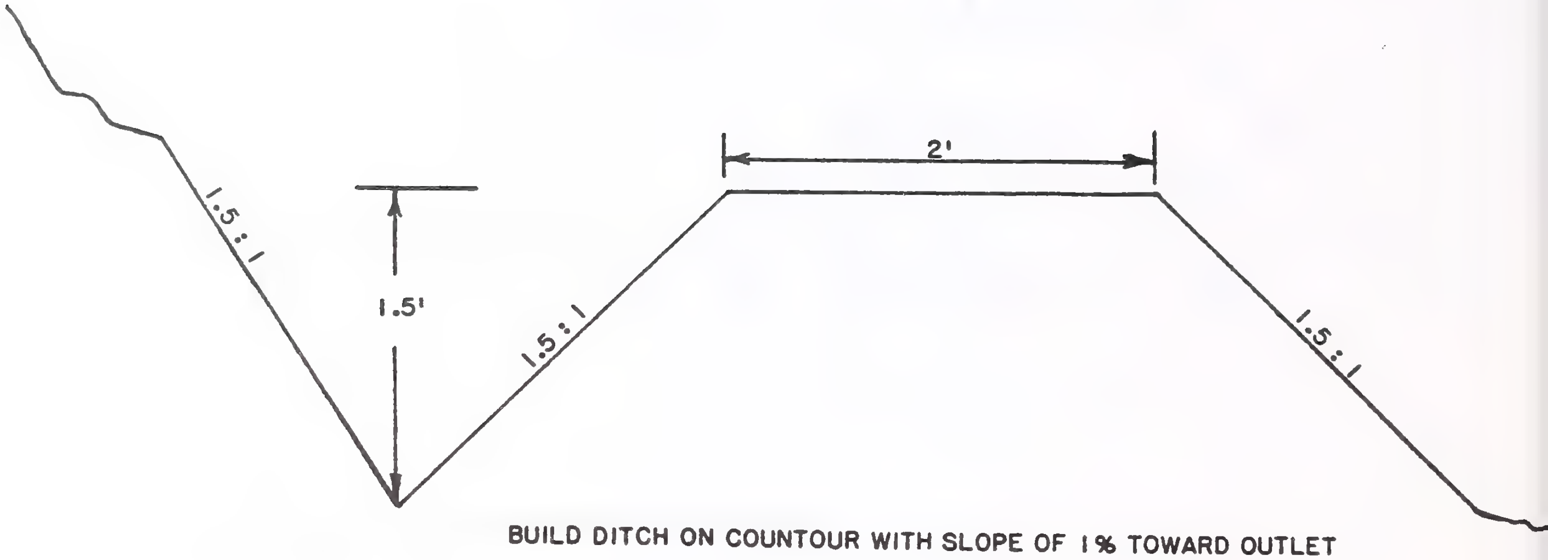
D DIKE TOP WIDTH $\frac{H}{5}$ IS MINIMUM

H POND DEPTH AS DESCRIBED IN SITE PLAN + 1 FT.

W POND BOTTOM WIDTH AS DESCRIBED IN SITE PLAN

ALL SLOPES SHOWN ARE MAXIMUM, FLATTER SLOPES
ARE PREFERRED WHERE TOPOGRAPHY WILL ALLOW

FIGURE II-5



BUILD DITCH ON COUNTOUR WITH SLOPE OF 1% TOWARD OUTLET

DIVERSION AND COLLECTION DITCH TYPICAL CROSS SECTION

FIGURE II-6

CYANAMID

APPENDIX 22

MSDS NO. 0290-01
CAS NO.
DATE: 08/14/82

MATERIAL SAFETY DATA

PRODUCT IDENTIFICATION

TRADEMARK:	**AERO® 350 Xanthate**
SYNONYMS:	None
CHEMICAL FAMILY:	Alkyl xanthate salt
MOLECULAR FORMULA:	n-C5H11OC(S)SK
MOLECULAR WGT.:	210

WARNING

CAUSES EYE AND SKIN IRRITATION

HAZARDOUS INGREDIENTS

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
No Permissible Exposure Limits (PEL), have been established by OSHA				

NFPA HAZARD RATING

Not Established

HEALTH HAZARD INFORMATION

EFFECTS OF OVEREXPOSURE:	Acute oral (rat) LD50 value is between 1.0 and 2.0 g/kg. Skin or eye contact with solutions of the product may cause primary irritation. Airborne dust may cause significant eye and skin irritation or irritation of the respiratory tract. Overexposure to carbon disulfide may produce the following effects: eye or respirtory tract irritation, skin irritation or sensitization, dizziness, headache, degeneration of peripherial nerves, manic depressive pyschosis and cardiovascular disorders.
FIRST AID:	In case of skin contact, remove contaminated clothing without delay. Flush skin thoroughly with water. Do not reuse clothing without laundering. In case of eye contact, immediately irrigate with plenty of water for 15 minutes. Refer to a physician if irritation persists. If vapor of AERO 350 Xanthate is inhaled, remove from exposure. Administer oxygen if there is difficulty in breathing.

EMERGENCY PHONE: 201/835-3100

EXPOSURE CONTROL METHODS

Utilize a closed system process where feasible. Where a closed system is not used, good enclosure and local exhaust ventilation should be provided to minimize exposure. Food, beverages, tobacco products should not be carried, stored or consumed where this chemcial is in use. Before eating, drinking or smoking wash face and hands with soap and water. Shower after completion of workshift. Launder work clothing at end of workshift prior to reuse. Store street clothing separately from work clothing and protective equipment. Work clothing and shoes must not be taken home. Where engineering controls are effective, respiratory protection is generally not required. If certain operations require respiratory protection, use a NIOSH approved respirator recommended by an industrial hygienist. Material causes eye or skin irritation on contact. A full facepiece respirator will provide eye and face protection. Wear the following as necessary to prevent skin contact; work pants, long sleeve work shirt and work gloves. For operations where eye or face contact can occur wear respiratory protection outlined above, (full facepiece) or dust proof goggles.

MATERIAL SAFETY DATA SHEET PAGE: 1

DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 16 OCT 79 DATE PRINTED: 4 JUN 84 PRODUCT CODE: 77669

PRODUCT NAME: SEPARAN (R) NP10 SYNTHETIC POLYMER MSD: 1117

INGREDIENTS (TYPICAL VALUES-NOT SPECIFICATIONS)	%
HYDROLYZED POLYACRYLAMIDE	
SOLIDS	95%
MOISTURE	5%

SECTION 1 PHYSICAL DATA

BOILING POINT: DECOMPOSES	SOL. IN WATER: VERY SOLUBLE
VAP PRESS: (MMHG @ 20C) VERY LOW	SP. GRAVITY: ----
VAP DENSITY (AIR=1): NOT APPLIC.	% VOLATILE BY VOL: NOT APPLICABLE

PPEARANCE AND ODOR: WHITE FREE FLOWING AMORPHOUS SOLID, LITTLE ODOR.

SECTION 2 FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE (TESTED TO 750F)	FLAMMABLE LIMITS	
METHOD USED: CLEVELAND OPEN CUP	LFL: NONE	UFL: NONE

EXTINGUISHING MEDIA: CO2, DRY CHEMICAL, WATER FOG, ALCOHOL FOAM.

SPECIAL FIRE FIGHTING EQUIPMENT AND HAZARDS: NONE.

SECTION 3 REACTIVITY DATA

STABILITY: SOLIDS SOFTEN AT 220-230C. DECOMPOSITION EVIDENT AT 270C. PRODUCTS FORMED ON COMPLETE COMBUSTION: CARBON DIOXIDE, WATER, AND NITROGEN DIOXIDE.

INCOMPATIBILITY: OXIDIZING MATERIAL.

HAZARDOUS DECOMPOSITION PRODUCTS: NITROGEN OXIDES.

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.

SECTION 4 SPILL, LEAK, AND DISPOSAL PROCEDURES

ACTION TO TAKE FOR SPILLS: SWEEP UP AND SALVAGE AS MUCH AS POSSIBLE. DISCARD REST.

DISPOSAL METHOD: BURN OR BURY IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

(CONTINUED ON PAGE 2)

(R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

MATERIAL SAFETY DATA SHEET PAGE: 2
DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 16 OCT 79 DATE PRINTED: 4 JUN 84 PRODUCT CODE: 77669
ODUCT (CONT'D): SEPARAN (R) NP10 SYNTHETIC POLYMER MSD: 1117

SECTION 5 HEALTH HAZARD DATA

EYE: SLIGHT TRANSIENT IRRITATION ONLY.

SKIN CONTACT: ESSENTIALLY NO IRRITATION.

SKIN ABSORPTION: NOT LIKELY TO BE ABSORBED IN ACUTELY TOXIC AMOUNTS.

INGESTION: LOW ACUTE ORAL TOXICITY; LD50 IS GREATER THAN 2000 MG/KG.

INHALATION: POSSIBLE NUISANCE DUST. DOW GUIDE 10 MG/M3.

SYSTEMIC & OTHER EFFECTS: POSSIBLE THROAT DRYNESS.

SECTION 6 FIRST AID

EYES: IRRIGATION OF THE EYE IMMEDIATELY WITH WATER FOR FIVE MINUTES IS GOOD SAFETY PRACTICE.

SKIN: WASH OFF IN FLOWING WATER.

INGESTION: LOW IN TOXICITY. INDUCE VOMITING IF LARGE AMOUNTS ARE INGESTED.

INHALATION: REMOVE TO FRESH AIR IF EFFECTS OCCUR. CONSULT MEDICAL PERSONNEL.

NOTE TO PHYSICIAN:
EYES: MAY CAUSE MILD IRRITATION. STAIN FOR EVIDENCE OF CORNEAL INJURY.
SKIN: NO EFFECT EXPECTED.
RESPIRATORY: INJURY IS UNLIKELY.
ORAL: PROBABLY LOW IN TOXICITY.
SYSTEMIC: CONSULT STANDARD LITERATURE. NO SPECIFIC ANTIDOTE. TREATMENT BASED ON SOUND JUDGMENT OF PHYSICIAN AND INDIVIDUAL REACTIONS OF THE PATIENT.

SECTION 7 SPECIAL HANDLING INFORMATION

EXPOSURE GUIDELINE(S): SOLIDS SOFTEN AT 220-230C. DECOMPOSITION EVIDENT AT 270C. PRODUCTS FORMED ON COMPLETE COMBUSTION: CARBON DIOXIDE, WATER, AND NITROGEN DIOXIDE.

VENTILATION: RECOMMEND CONTROL OF DUST TO SUGGESTED GUIDE.

RESPIRATORY PROTECTION: IF REQUIRED, USE AN APPROVED DUST RESPIRATOR.

PROTECTIVE CLOTHING: NONE REQUIRED.

E PROTECTION: NOT NORMALLY NECESSARY. SAFETY GLASSES WITHOUT SIDE SHIELDS RECOMMENDED.

(CONTINUED ON PAGE 3)

(R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY

FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT: METHOD:	113 F (45.0 C) Closed Cup
FLAMMABLE LIMITS (% BY VOL):	Not Available
AUTOIGNITION TEMP:	Not Available
DECOMPOSITION TEMP:	Not Available
FIRE FIGHTING:	Use alcohol foam, carbon dioxide or dry chemical to extinguish fires. Water may be ineffective. Use water to keep containers cool. Wear self-contained, positive pressure breathing apparatus and full firefighting protective clothing. See Exposure Control Methods for special protective clothing. Dike area and use limited amounts of extinguishing agent to prevent runoff.

REACTIVITY DATA

STABILITY: CONDITIONS TO AVOID:	Stable None known
POLYMERIZATION: CONDITIONS TO AVOID:	Will Not Occur None known
INCOMPATIBLE MATERIALS:	Strong oxidizing agents; mineral acids.
HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition or combustion may produce carbon monoxide and/or carbon dioxide.

PHYSICAL PROPERTIES

APPEARANCE AND ODOR:	Clear liquid; mild organic odor
BOILING POINT:	320-355 F; 160-179.4 C
MELTING POINT:	Not Available
VAPOR PRESSURE:	Not Available
SPECIFIC GRAVITY:	∾0.8 @ 20 C
VAPOR DENSITY:	Not Available
% VOLATILE (BY VOL):	100
OCTANOL/H_2O PARTITION COEF.:	Not Available
pH:	Not Available
SATURATION IN AIR (BY VOL):	Not Available
EVAPORATION RATE:	Not Available
SOLUBILITY IN WATER:	Negligible

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

Where exposure level is not known, wear NIOSH approved positive pressure self-contained respirator. Where exposure level is known, wear NIOSH approved respirator suitable for level of exposure. In addition to the protective clothing/equipment in Exposure Control Methods, wear impervious boots. Remove sources of ignition. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush area with water.

WASTE DISPOSAL

Disposal must be made in accordance with applicable governmental regulations.

SPECIAL PRECAUTIONS

HANDLING AND STORAGE/OTHER:

Areas containing this material should have fire safe practices and electrical equipment in accordance with Electrical and Fire Protection Codes (NFPA-30) governing Class II Combustible Liquids.

Marvin A. Friedman

Marvin A. Friedman, Ph.D., Director of Toxicology and Product Safety

This information is given without any warranty or representation. We do not assume any legal responsibility for same, nor do we give permission, inducement, or recommendation to practice any patented invention without a license. It is offered solely for your consideration, investigation and verification. Before using any product read its label.

CYANAMID

MSDS NO. 1816-02
CAS NO.
DATE: 07/29/82

MATERIAL SAFETY DATA

PRODUCT IDENTIFICATION

TRADEMARK:	**AEROFROTH® 76 Frother**
SYNONYMS:	None
CHEMICAL FAMILY:	Alcohols
MOLECULAR FORMULA:	Mixture
MOLECULAR WGT.:	Mixture

WARNING

HARMFUL IF INHALED
CAUSES EYE AND SKIN IRRITATION
COMBUSTIBLE LIQUID AND VAPOR.

HAZARDOUS INGREDIENTS

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
n-Butyl alcohol	000071-36-3	5.0	100 ppm	OSHA

NFPA HAZARD RATING

Not Established

HEALTH HAZARD INFORMATION

EFFECTS OF OVEREXPOSURE:	Acute oral (rat) LD50 value of AEROFROTH 76 is approximately 3.2 g/kg. Although acute dermal (rabbit) LD50 value of AEROFROTH 76 is in excess of 20.0 ml/kg, it is still a moderately strong skin irritant. AEROFROTH 76 is moderately irritating to the eyes. The 6 hour rat LC50 is in excess of 20.0 mg/L, suggesting that the material is not likely to produce any significant acute effects by inhalation.
FIRST AID:	In case of skin contact, remove contaminated clothing without delay. Flush skin thoroughly with water. Do not reuse clothing without laundering. In case of eye contact, immediately irigate with plenty of water for 15 minutes. Get medical attention.

EMERGENCY PHONE: 201/835-3100

EXPOSURE CONTROL METHODS

Where a closed system is not used, good enclosure and local exhaust ventilation should be provided to minimize exposure. Where concentrations are below the PEL, no respiratory protection is required. For spills or leaks, such protection may be necessary. Where exposures exceed PEL, use respirator approved by NIOSH for the material and level of exposure. See "GUIDE TO INDUSTRIAL RESPIRATORY PROTECTION" (NIOSH). Material causes eye and skin irritation on contact. A full facepiece respirator will provide eye and face protection. Wear the following as necessary to prevent skin contact; work pants, long sleeve work shirt and impervious gloves. For operations where eye or face contact can occur wear chemical splash proof goggles.

FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT:	This product has no flash point or explosive limits. Carbon disulfide may be evolved; however, (see Reactivity Data) with a flash point of -22 F.
FLAMMABLE LIMITS (% BY VOL):	1.25 lower; 50.0 upper (residual carbon disulfide)
AUTOIGNITION TEMP:	248 F; 120 C (residual carbon disulfide)
DECOMPOSITION TEMP:	491-536 F; 255-280 C (residual carbon disulfide)
FIRE FIGHTING:	Use carbon dioxide or dry chemical to extinguish fires. Do not use water. Do not flush to sewers. Wear self-contained, positive pressure breathing apparatus and full firefighting protective clothing. See Exposure Control Methods for special protective clothing. Dust may be explosive if mixed with air in critical proportions and in the presence of a source of ignition. Liberates carbon disulfide slowly in aqueous solution, when heated, or in presence of moisture. Due to its high vapor density (2.2 @ 100 F) carbon disulfide may accumulate in the bottom of tanks or drums containing this product or solutions of it and create a fire or explosion hazard.

REACTIVITY DATA

STABILITY:	Unstable
CONDITIONS TO AVOID:	Heat or moisture will liberate carbon disulfide which is toxic and explosive.
POLYMERIZATION:	Will Not Occur
CONDITIONS TO AVOID:	None known
INCOMPATIBLE MATERIALS:	Acids, strong oxidizing agents, water (including atmospheric moisture).
HAZARDOUS DECOMPOSITION PRODUCTS:	Heat or moisture will liberate carbon disulfide. Thermal decomposition may produce carbon monoxide, carbon dioxide, sulfur oxides and/or carbon disulfide.

PHYSICAL PROPERTIES

APPEARANCE AND ODOR:	Yellow pellets or powder; slight, disagreeable odor
BOILING POINT:	Not Applicable
MELTING POINT:	491-536 F; 255-280 C
VAPOR PRESSURE:	Not Applicable
SPECIFIC GRAVITY:	Not Available
VAPOR DENSITY:	Not Applicable
% VOLATILE (BY VOL):	<15.0
OCTANOL/H_2O PARTITION COEF.:	Not Available
pH:	Not Applicable
SATURATION IN AIR (BY VOL):	Not Applicable
EVAPORATION RATE:	Not Applicable
SOLUBILITY IN WATER:	Appreciable

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

Wear NIOSH approved air purifying cartridge or canister respirator. Same protective clothing/equipment as in Exposure Control Methods. Vacuum spill instead of sweeping.

WASTE DISPOSAL

Disposal must be made in accordance with applicable governmental regulations.

SPECIAL PRECAUTIONS

HANDLING AND STORAGE/OTHER:

Store in a cool, dry, well-ventilated area. Maintain good housekeeping to control dust accumulations. Areas where handling or use may result in the evolution of carbon disulfide should have fire safe practices and electrical equipment in accordance with Electrical and Fire Protection Codes (NFPA-30) governing Class I Flammable Liquids.

Marvin A. Friedman

Marvin A. Friedman, Ph.D., Director of Toxicology and Product Safety

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CYANAMID

MSDS NO. 0414-01
CAS NO.
DATE: 08/13/82

MATERIAL SAFETY DATA

PRODUCT IDENTIFICATION

TRADEMARK:	**AEROFLOAT® 208 Promoter, Aqueous**
SYNONYMS:	None
CHEMICAL FAMILY:	Phosphorodithioate salt
MOLECULAR FORMULA:	Mixture
MOLECULAR WGT.:	Mixture

WARNING

CAUSES BURNS OF EYES AND SKIN

HAZARDOUS INGREDIENTS

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
No Permissible Exposure Limits (PEL), have been established by OSHA				

NFPA HAZARD RATING

Not Established

HEALTH HAZARD INFORMATION

EFFECTS OF OVEREXPOSURE:	Acute oral (rat) and acute dermal (rabbit) LD50 values are 8.46 g/kg and 5.61 g/kg, respectively. Marked eye irritation and skin corrosion were produced during primary irritation studies with rabbits.
FIRST AID:	In case of skin contact, remove contaminated clothing without delay. Wear impervious gloves. Cleanse skin thoroughly with soap and water. Do not omit cleaning hair or under fingernails if contaminated. Do not reuse clothing without laundering. Do not reuse contaminated leatherware. In case of eye contact, immediately irrigate with plenty of water for 15 minutes. Obtain medical attention without delay.

EMERGENCY PHONE: 201/835-3100

AMERICAN CYANAMID COMPANY, WAYNE, NEW JERSEY 07470

EXPOSURE CONTROL METHODS

Engineering controls are not usually necessary, if good hygiene practices are strictly followed. Where engineering controls are effective, respiratory protection is generally not required. If certain operations require respiratory protection, use a NIOSH approved respirator recommended by an industrial hygienist. Material causes eye and skin burns or severe irritation on contact. A full facepiece respirator will provide eye and face protection. Wear the following as necessary to prevent skin contact; work pants, long sleeve work shirt, impervious gloves and impervious apron. For operations where eye or face contact can occur wear respiratory protection outlined above (full facepiece) or chemical splash proof goggles and a faceshield. Provide eyewash fountain and safety shower in close proximity to points of potential exposure.

MATERIAL SAFETY DATA SHEET PAGE: 3
DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 16 OCT 79 DATE PRINTED: 4 JUN 84 PRODUCT CODE: 77669
DUCT (CONT'D): SEPARAN (R) NP10 SYNTHETIC POLYMER MSD: 1117

SECTION 8 SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: PRACTICE REASONABLE CAUTION AND PERSONAL CLEANLINESS. PRODUCT BECOMES SLIPPERY WHEN WET. PRACTICE GOOD HOUSEKEEPING AT ALL TIMES TO PREVENT SLIPPERY FLOORS.

ADDITIONAL INFORMATION: NEW MSDS 10/16/79

LAST PAGE

(R) INDICATES A TRADEMARK OF THE DOW CHEMICAL COMPANY
THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH, BUT NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE. CONSULT THE DOW CHEMICAL COMPANY FOR FURTHER INFORMATION.

FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT: METHOD:	>200 F (>93.3 C) Closed Cup
FLAMMABLE LIMITS (% BY VOL):	Not Available
AUTOIGNITION TEMP:	Not Available
DECOMPOSITION TEMP:	Not Available
FIRE FIGHTING:	Use water, carbon dioxide or dry chemical to extinguish fires. Wear self-contained, positive pressure breathing apparatus and full firefighting protective clothing. See Exposure Control Methods for special protective clothing. Sulfur dioxide or hydrogen sulfide may be formed under fire conditions. Do not flush to sewer which may contain acid. This could result in generation of toxic and explosive hydrogen sulfide gas.

REACTIVITY DATA

STABILITY: CONDITIONS TO AVOID:	Stable None known
POLYMERIZATION: CONDITIONS TO AVOID:	Will Not Occur None known
INCOMPATIBLE MATERIALS:	This product contains a neutralized dithioacid. Avoid contact with strong oxidizing agents and mineral acids.
HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition or combustion may produce carbon monoxide, carbon dioxide, hydrogen sulfide and/or oxides of sulfur and phosphorus.

PHYSICAL PROPERTIES

APPEARANCE AND ODOR:	Clear, pale yellow to dark amber, mobile liquid; noticeable odor
BOILING POINT:	Not Available
MELTING POINT:	∾-5.0 F; ∾-20.5 C (freezing point)
VAPOR PRESSURE:	Similar to water
SPECIFIC GRAVITY:	1.1175 @25 C
VAPOR DENSITY:	Similar to water
% VOLATILE (BY VOL):	59 (water by weight)
OCTANOL/H_2O PARTITION COEF.:	Not Available
pH:	11.0 minimum
SATURATION IN AIR (BY VOL):	Similar to water
EVAPORATION RATE:	Similar to water
SOLUBILITY IN WATER:	Complete

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

In addition to the protective clothing/equipment in Exposure Control Methods, wear impervious boots and a rain suit. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush area with water.

WASTE DISPOSAL

Disposal must be made in accordance with applicable governmental regulations.

SPECIAL PRECAUTIONS

HANDLING AND STORAGE/OTHER:

AEROFLOAT 208 Promoter should not be mixed with acids since evolution of toxic and explosive hydrogen sulfide gas could result. This precaution does not, of course, apply to addition of this reagent to flotation pulps in amounts customarily used in flotation.

Marvin A. Friedman

Marvin A. Friedman, Ph.D., Director of Toxicology and Product Safety

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MATERIAL SAFETY DATA SHEET

IDENTIFICATION

Name
Sodium Cyanide

Synonyms
Cyanide of Sodium

CAS Name
Sodium Cyanide

I.D. Nos./Codes NIOSH Registry No. VZ 75250
Wiswesser Code NC-NA-

Manufacturer/Distributor
E. I. du Pont de Nemours & Co., (Inc.)

Address
Wilmington, DE 19898

Tradename:
Cyanobrik®/Cyanogran®

Chemical Family
Metal Cyanide

CAS Registry No.
143-33-9

Formula:
$NaCN$

Product Information and Emergency Phone
(901) 357-1546

Transportation Emergency Phone
(800) 424-9300

HAZARDOUS COMPONENTS

Material(s)	*Approximate %*
Sodium Cyanide	100%

PHYSICAL DATA

Boiling Point, 760 mm Hg
1496°C/2725°F

Specific Gravity
1.6

Vapor Density
(Air = 1) 1.7

% Volatiles by Vol. 0

Melting Point
564°C/1047°F

Vapor Pressure
Not applicable

Solubility in H_2O
37% (at 20°C)

Evaporation Rate (Butyl Acetate = 1)
Not applicable

Form	*Appearance*	*Color*	*Odor*
Solid	Granular	White	Pungent

pH Information
Not available

Octanol/Water Partition Coefficient
Not applicalbe

FIRE AND EXPLOSION DATA

Flash Point *Method*
None

Autoignition Temperature
Not applicable

Flammable Limits in Air, % by Vol. *Lower* *Upper*
Not applicable

Fire and Explosion Hazards
Will not burn

Extinguishing Media
Not applicable

Special Fire Fighting Instructions Do not use water if involved in fire. Toxic water solutions may escape to surrounding areas. Contact with acids or acid salts will release highly toxic and flammable hydrogen cyanide gas.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process. The information set forth herein is furnished free of charge and is based on technical data that Du Pont believes to be reliable. It is intended for use by persons having technical skill and at their own discretion and risk. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information. Nothing herein is to be taken as a license to operate under or a recommendation to infringe any patents.

HAZARDOUS REACTIVITY

Instability
Will react with acids to liberate highly toxic and flammable hydrogen cyanide gas.

Incompatibility

Decomposition

Polymerization

Will not occur

HEALTH HAZARD INFORMATION

Exposure Limits

OSHA Time Weighted Average (as CN) = 5 mg/m^3.

Routes of Exposure and Effects
Highly toxic; may be rapidly fatal if swallowed or inhaled.
Causes eye burns.
May irritate skih.

First Aid
Study and plan First Aid action before beginning work with cyanide --- See attached page 3.

PROTECTION INFORMATION

Ventilation
Use only with adequate ventilation.

Personal Protective Equipment Use respirator if there is danger of breathing dust; air or oxygen mask in emergencies.

Other Wear coverall chemical safety goggles and/or face shield. Rubber gloves for solutions. Dry cotton gloves for dry material.

DISPOSAL PROCEDURES

Aquatic Toxicity
Not available

Spill, Leak or Release Do not breathe dust or gas. Do not get in eyes. Avoid skin contact. Sweep up spillage and store in covered container pending transfer to disposal facility.

Waste Disposal Comply with Federal, State and local regulations. Do not flush sodium cyanide into sewers which may contain an acid. If approved, neutralize with sodium or calcium hypochlorite and flush to waste treatment system or call disposal contractor.

SHIPPING PRECAUTIONS

Transportation
DOT Shipping Name = Sodium Cyanide, solid (or solution). DOT class = Poison B

Shipping Containers 49 STCC Code = 4923228. UN No. 1689. IMCO Class 6.1. Railroad tank cars. Flo-bins®. Drums.

Storage Conditions Store in dry place. Keep container closed and away from acids, weak alkaline salts and oxidizing agents. Do not store near foodstuffs.

REFERENCES AND ADDITIONAL INFORMATION

Do not breathe dust or gas. Do not get in eyes. Avoid contact with skin. Do not carry foodstuffs, beverages or tobacco where contamination with cyanide is possible. Wash thoroughly after handling. Wash contaminated clothing before reuse.

See: Du Pont Bulletin on Sodium Cyanide
National Fire Protection Association Manual 49, 491M.

DATE: 6/79

United States Department of Agricul
Forest Service

SPECIAL USE PERMIT
Act of October 21, 1976
(P.L. 94-579) ~~Act of June 4, 1897~~
This permit is revocable and nontransferable
(Ref. FSM 2710)

a. Record no. (1-2) 70	Region (3-4) One 01	c. Forest (5-6) Gallatin
d. District (7-8) Gardiner 03	e. User number (9-12) 4301	f. Kind of use (1 Water Trans. (Buried)
g. State (16-17) Montana 30	h. County (18-20) Park 067	k. Card no. (21)

Permission is hereby granted to Homestake Mining Company Appendix 23 / X-99

of P.O. Box 92, Gardiner, Montana 59030

hereinafter called the permittee, to use subject to the conditions set out below, the following describec or improvements:

A right-of-way across National Forest land for 1008 feet of pipeline located in the SE¼ Sec. 4, T. 9 S., R. 9 E., PMM., Park County, Montana as shown on the attached plat dated 12/16/81 by P. W. Hoppe.

This permit covers Approx. .3 acres and/or 1008 feet ~~miles~~ and is issued for the purpo:

Construction and maintenance of a municipal water system for Jardine consistin of the following:

1 infiltration structure located in Pine Creek (30' in circumference
1 ROW for buried water pipeline 12' wide and 1008' long

1. Construction or occupancy and use under this permit shall begin within one months, construction, if any, shall be completed within 24 months, from the date of the permit. T use shall be actually exercised at least 365 days each year, unless otherwise authori: in writing.

2. In consideration for this use, the permittee shall pay to the Forest Service, U.S. Department of Agriculture, the sum of twenty-five Dollars ($ 25.00) for the pe from January 1 19 82, to December 31, 19 82, and there: annually on January 1
twenty-five Dollars ($ 25.00
Provided, however, Charges for this use may be made or readjusted whenever necessary to place the charges on a basis commensurate with the value of use authorized by this permit.

3. This permit is accepted subject to the conditions set forth herein, and to conditions 18
30 attached hereto and made a part of this permit.

PERMITTEE	NAME OF PERMITTEE HOMESTAKE MINING COMPANY	SIGNATURE OF AUTHORIZED OFFICER Alvin M. Hart TITLE Project Geologist	DATE 3/22/82
ISSUING OFFICER	NAME AND SIGNATURE John T. Drake JOHN T. DRAKE	TITLE Forest Supervisor	DATE 3/31/8

(CONTINUED ON REVERSE)

2700-4a (7/7

revision of layout or construction plans for this area must be approved in advance and in writing by the forest supervisor. Trees or shrubbery on the permitted area may be removed or destroyed only after the forest officer in charge has approved, and has marked or otherwise designated that which may be remove or destroyed. Timber cut or destroyed will be paid for by the permittee as follows: Merchantable timber appraised value; young-growth timber below merchantable size at current damage appraisal value; *provide* that the Forest Service reserves the right to dispose of the merchantable timber to others than the permittee at no stumpage cost to the permittee. Trees, shrubs, and other plants may be planted in such manner and in such places about the premises as may be approved by the forest officer in charge.

5. The permittee shall maintain the improvements and premises to standards of repair, orderliness, neatness, sanitation, and safety acceptable to the forest officer in charge.

6. This permit is subject to all valid claims.

7. The permittee, in exercising the privileges granted by this permit, shall comply with the regulation of the Department of Agriculture and all Federal, State, county, and municipal laws, ordinances, or regul tions which are applicable to the area or operations covered by this permit.

8. The permittee shall take all reasonable precautions to prevent and suppress forest fires. No material shall be disposed of by burning in open fires during the closed season established by law or regula tion without a written permit from the forest officer in charge or his authorized agent.

9. The permittee shall exercise diligence in protecting from damage the land and property of the Unit States covered by and used in connection with this permit, and shall pay the United States for any damag resulting from negligence or from the violation of the terms of this permit or of any law or regulation app cable to the National Forests by the permittee, or by any agents or employees of the permittee acting within the scope of their agency or employment.

10. The permittee shall fully repair all damage, other than ordinary wear and tear, to national forest ro and trails caused by the permittee in the exercise of the privilege granted by this permit.

11. No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this agreement or to any benefit that may arise herefrom unless it is made with a corporation for it general benefit.

12. Upon abandonment, termination, revocation, or cancellation of this permit, the permittee shall remov within a reasonable time all structures and improvements except those owned by the United States, and shall restore the site, unless otherwise agreed upon in writing or in this permit. If the permittee fails to remove all such structures or improvements within a reasonable period, they shall become the property of the United States, but that will not relieve the permittee of liability for the cost of their removal and restoration of the site.

13. This permit is not transferable. If the permittee through voluntary sale or transfer, or through enforcement of contract, foreclosure, tax sale, or other valid legal proceeding shall cease to be the owne of the physical improvements other than those owned by the United States situated on the land described in this permit and is unable to furnish adequate proof of ability to redeem or otherwise reestablish title t said improvements, this permit shall be subject to cancellation. But if the person to whom title to said improvements shall have been transferred in either manner provided is qualified as a permittee and is willing that his future occupancy of the premises shall be subject to such new conditions and stipulation as existing or prospective circumstances may warrant, his continued occupancy of the premises may be authorized by permit to him if, in the opinion of the issuing officer or his successor, issuance of a permit is desirable and in the public interest.

14. In case of change of address, the permittee shall immediately notify the forest supervisor.

15. The temporary use and occupancy of the premises and improvements herein described may be sublet by the permittee to third parties only with the prior written approval of the forest supervisor but the permittee shall continue to be responsible for compliance with all conditions of this permit by persons to whom such premises may be sublet.

16. This permit may be terminated upon breach of any of the conditions herein or at the discretion of th regional forester or the Chief, Forest Service.

17. In the event of any conflict between any of the preceding printed clauses or any provisions thereof an any of the following clauses or any provisions thereof, the following clauses will control

18. A late payment charge in addition to the regular fees shall be made for failure to meet the fee payment due date or any of the dates specified for submission of statements required for fee calculation. The late payment charge shall be $15.00, or an amount calculated by applying the current rate prescribed by Treasury Fiscal Requirements Manual Bulletins to the overdue amount for each 30-day period, or fraction thereof, that the payment is overdue, whichever is greater. If the due date falls on a nonworkday, the late payment charge will not apply until the next workday.

19. During the performance of this permit, the permittee agrees:

a. In connection with the performance of work under this permit, including construction, maintenance, and operation of the facility, the permittee shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

b. The permittee and his employees shall not discriminate by segregation or otherwise against any person on the basis of race, color, religion, sex, or national origin by curtailing or refusing to furnish accommodations, facilities, services, or use privileges offered to the public generally.

c. The permittee shall include and require compliance with the above nondiscrimination provisions in any subcontract made with respect to the operations under this permit.

d. Signs setting forth this policy of nondiscrimination to be furnished by the Forest Service will be conspicuously displayed at the public entrance to the premises, and at other exterior or interior locations as directed by the Forest Service.

20. The permittee shall indemnify the United States against any liability for damage to life or property arising from the occupancy or use of National Forest lands under this permit.

21. Avalanches, rising waters, high winds, falling limbs or trees, and other hazards are natural phenomenons in the forest that present risks which the permittee assumes. The permittee has the responsibility of inspecting his site, lot, right-of-way, and immediate adjoining area for dangerous trees, hanging limbs, and other evidence of hazardous conditions and, after securing permission from the Forest Service, of removing such hazards.

22. Drinking water testing shall be accomplished by the permittee in accordance with Federal, State, and local regulations, or as directed by State health officials. As a minimum, a sample of the drinking water shall be submitted by the permittee to a certified laboratory for bacteriological analysis prior to opening the seasonal system to public use, and at a rate of one test per calendar quarter during the season of operation. Copies of all test results will be forwarded to the Forest Service representative, and appropriate action taken to correct any deficiencies as may be deemed necessary by the Forest Service and/or State or local health officials.

In addition, the permittee shall submit a drinking water sample to a certified laboratory for nitrate analysis once every three years for analysis and submit results to the Forest Service representative. Nitrate (as nitrogen) levels in excess of 10 milligrams per liter will not be supplied to the public.

23. The permittee shall protect the scenic esthetic values of the area under this permit, and the adjacent land, as far as possible with the authorized use, during construction, operation, and maintenance of the improvements.

24. The permittee shall be responsible for the prevention and control of soil erosion and gullying on the area covered by this permit and lands adjacent thereto, and shall provide preventive measures as required by the District Ranger.

25. The permittee agrees to take all reasonable precaution to avoid damage to property and resources of the United States, and diligently to undertake suppression action in the event of fire resulting from the exercise of the privileges herein granted.

26. Unless sooner terminated or revoked by the Regional Forester in accordance with the provisions of the permit, this permit shall expire and become void on December 31, 1991, but a new permit to occupy and use the same National Forest land may be granted provided the permittee will comply with the then-existing laws and regulations governing the occupancy and use of National Forest lands and shall have notified the District Ranger not less than six months prior to said date that such new permit is desired.

27. This permit may be terminated for nonpayment of fees and/or any additional charges for late payment.

28. The permittee agrees to permit the free and unrestricted access to and upon the premises at all times for all lawful and proper purposes not inconsistent with the intent of the permit or with the reasonable exercise and enjoyment by the permittee of the privileges thereof.

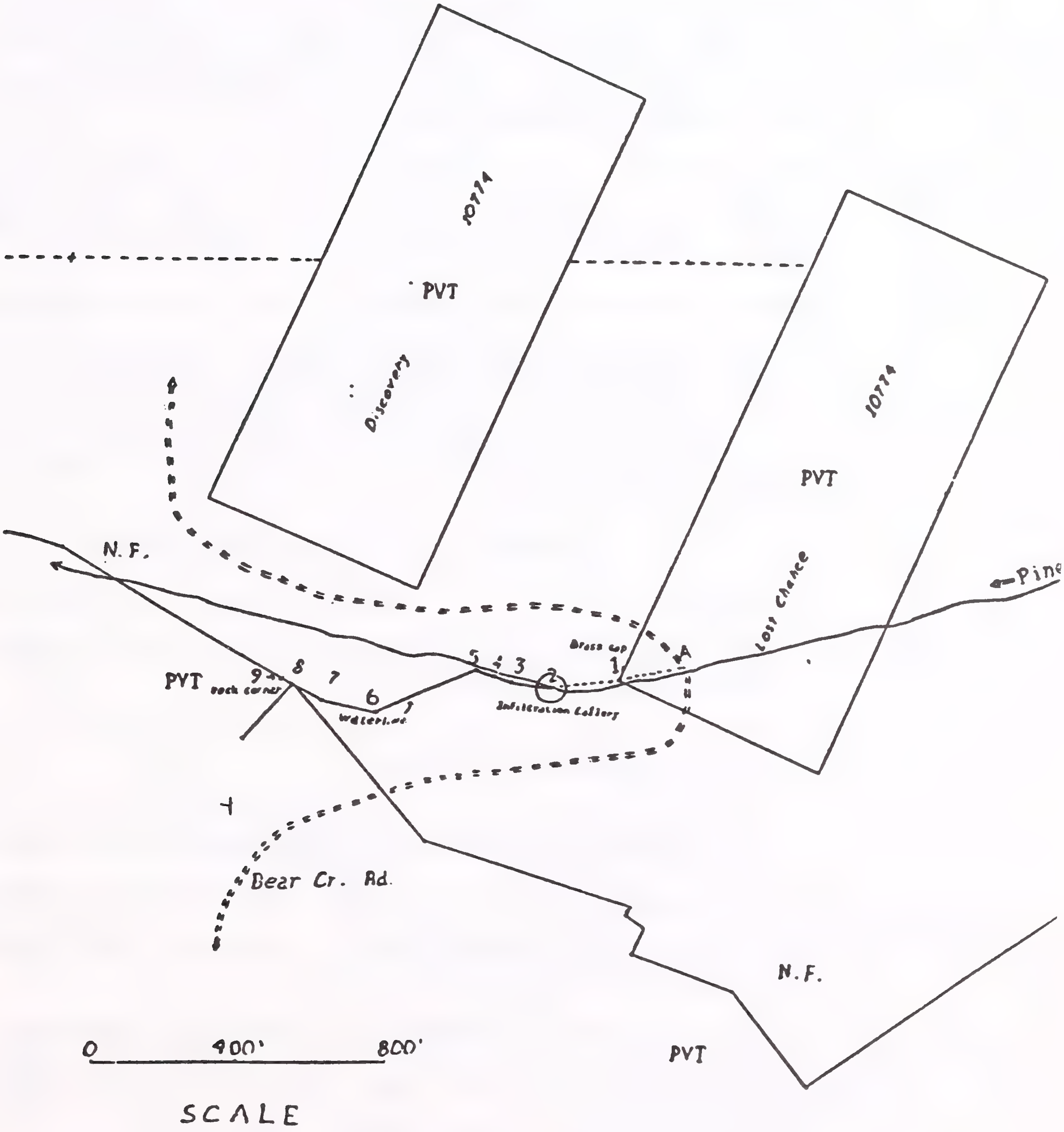
29. This permit is granted with the express understanding that should future location of Government improvements or road rights-of-way require the relocation of the permittee's improvements, such relocation will be done by the permittee at his expense within sixty (60) days following request to relocate.

30. This permit confers no right to the use of water by the permittee.

JARDINE WATER SYSTEM
LOT 9
Sec 4 T 9S., R.9E

STA.	A-1	S87° W	225'
STA	1-2	S56° W	255'
STA.	2-3	N76° W	144'
STA.	3-4	N58° W	61'
STA.	4-5	N82° W	75'
STA.	5-6	S72° W	375'
STA.	6-7	N73° W	205'
STA.	7-8	N55° W	118'
STA	8-9	N40° W	30'

Infiltration gallery 30' circumference in creek around STA. 2.
Right-of-way for system 12' (6' either side of center line).



STA. A is at junction of Pine Creek and Bear Creek Road
STA. 1 is corner 3 of Last Chance Claim; brass cap.
STA. 2 is valve intake
STA. 3 - 7 are points along waterline
STA. 8 is where waterline leaves N.F. land and enters private
STA. 9 is a rock on which corner 2 (claim 0284) and corner 3
(claim 0117) is carved

BY: P. W. [illegible]
12/[illegible]/81

Appendix 24

Pipeline Design Features

Slurry Transportation and Spill Prevention

1. Materials under consideration for use in constructing the slurry and return water pipelines include a polyurethane pipe. This type of pipe is manufactured by Dupont, under the trade name of "SCLAIR." This pipe is flexible and virtually resistant to corrosion or abrasion. It will withstand pressures up to 300 psi.

2. The polyurethane type pipe described above is flexible, and capable of withstanding a significant seismic event. Pipes up to three feet in diameter of this material are currently being used by ACNC's parent company (INCO Ltd.) at its various mine and mill facilities.

   Technical drawings will be provided as part of detailed engineering.

3. "Failsafe" type controls can be used to substantially reduce the potential for spillage from the slurry and backfill lines. This type of control of materials in the chemical process industry (CPI) is directly applicable to control of pipelines at the JJV project. These controls have evolved over several decades to the current state of automated, high-tech dependability.

   Control devices applicable to project pipelines include:

   a. Speciality piping for strength and for corrosion resistance.

   b. Check valves to reduce static head pressures on slopes and limit possible spill volumes.

   c. Electrically actuated control valves to stop slurry flow and minimize potential spillage.

   d. Pressure sensitive and/or mechanical flow meters to monitor remote pipeline flow conditions and trigger pump/valve emergency shutdown.

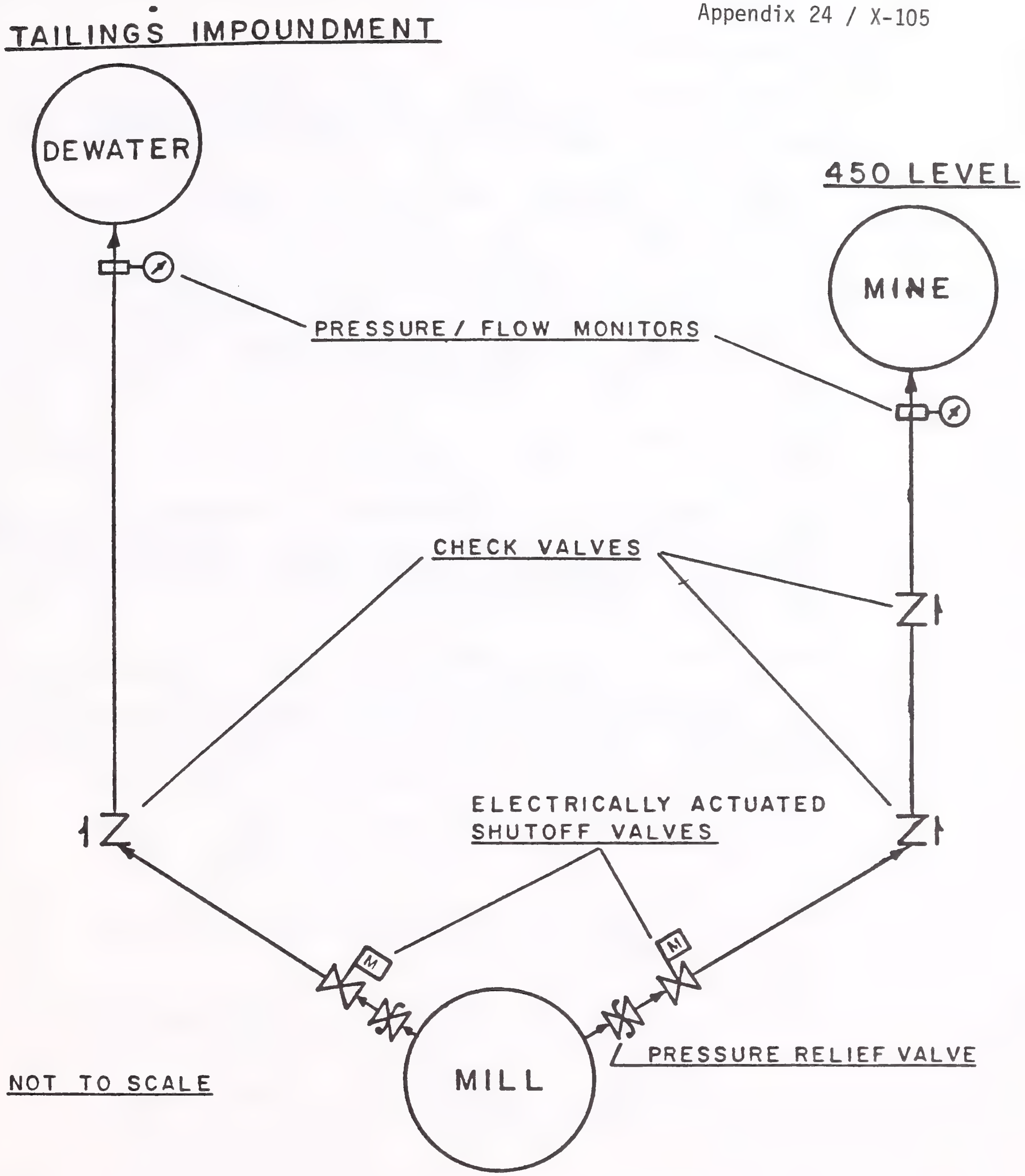
   e. Solid state electronic controlling and monitoring hardware.

Currently available manufacturer's literature for typical control equipment is attached for reference.

A typical flow control schematic for project slurry pipelines is shown as Figure C-1. A mylar of this schematic is attached for your use. This arrangement represents only one of many possible to provide state-of-the-art environmental protection.

4. In addition to advance slurry flow control, ditches and ponds are available for physical containment in the event of a spill from the slurry or return water pipelines. The 2 foot by 2 foot containment ditch described in the Operating Permit Application would provide a volume of 400 cubic feet or 2,992 gallons per 100 feet of length. This is 209%, or 20 times, the volume of 200 feet of pipe in operation.

FIGURE C-1



FLOW CONTROL SCHEMATIC
SLURRY PIPELINES
TYPICAL ARRANGEMENT

McLEAN 2/5/8

The sand backfill line operates, at the most, during one shift per day. A special crew is assigned to this task. The crew maintains the line when not in use. When in use, the line is continually patrolled.

In addition, containment ponds have been located at the base of the hillside between the mine and the mill, and at the mill. These containment ponds will be sized with sufficient capacity to completely contain a spill in the entire reach of pipeline upgradient from the pond. A pump will also be activated in the containment ponds in the event of a spill in order to return the slurry to the mill, allowing time for only minimal seepage. The location of the containment ponds is as shown on revised Exhibit II-1. Engineering data on the slurry pipeline volumes is shown in Exhibit C-1.

Technical drawings will be included as part of detailed design engineering.

5. A containment pond will be located at the point where the slurry pipeline exits the mill, as discussed in C.4 above, and shown on the revised Exhibit II-1. The pond will be sized to contain the volume of the first 1,000 feet of pipeline which, along with the containment ditch, will provide excess capacity in the event of a spill.

   Design details will be included as part of detailed engineering.

6. Details of the series of drop boxes or energy dissipators, including cross sections and plan views, will be included as part of detailed engineering.

EXHIBIT C-1

JARDINE JOINT VENTURE
SLURRY PIPELINE CONTROL

ENGINEERING DATA

VOLUMES:

VOLUME OF SLURRY PER 100 FT. OF 6" DIAMETER PIPE

VOLUME = LENGTH X CROSS SECTIONAL AREA
= 1200 in X 3.14159 X 3 in X 3in
= 33924 cu. in.

1 CUBIC FOOT = 1728 CUBIC INCHES

1 CUBIC FOOT = 7.48 GALLONS

THEREFORE, VOLUME PER 100 ft. - 6" PIPE = 146.83 GALLONS

STATIC HEAD:

STATIC HEAD = VERTICAL DROP X DENSITY /(144 sq.in./sq.ft.)

BASED ON 10 cu.ft. PER TON, AND A SOLID TO WATER RATIO OF 40 : 60 , SLURRY DENSITY IS APPROXIMATELY 117.4 lbs. / cu.ft.

VERTICAL DISTANCES: MILL TO 450 LEVEL = 665 ft.
: MILL TO 6575 GRADE = 75 ft.

MAXIMUM HEAD TO 450 LEVEL = 542.3 psi

MAXIMUM HEAD TO IMPOUNDMENT = 61.1 psi

ENGINEERING DATA - CONTINUED

PIPELINE VOLUMES:

MILL TO 450 LEVEL = 2217 ft.
VOLUME PER 100 FEET = 142.83 gal.

TOTAL VOLUME = 3166.5 GALLONS

MILL TO IMPOUNDMENT AREA = 3883 ft.
VOLUME PER 100 FEET = 142.83 gal.

TOTAL VOLUME = 5546.0 GALLONS

** IN ADDITION TO A CONTAINMENT POND(S) NEAR THE MILL, A 2 ft. X 2 ft. SPILL DITCH WOULD PROVIDE A VOLUME OF 400 CUBIC FEET OR 2992 GALLONS PER 100 FEET OF LENGTH. THIS IS 2095 % OR 20 TIMES THE VOLUME IN 100 FEET OF PIPE IN OPERATION.

Appendix 25

Estimated Effects of Mining on Streamflow in Bear Creek

Month	Estimated long-term mean discharge	Estimated project demands[1]	Estimated flow during mining[2]	Minimum instream requirements[3]
October	25.0[4]	1.09	23.91	18.20
November	16.0	0.65	15.35	16.50
December	13.0	0.65	12.35	12.50
January	13.0	0.65	12.35	10.10
February	12.5	0.65	11.85	9.63
March	13.0	0.65	12.35	10.80
April	18.0	0.65	17.35	32.30
May	125.0	1.09	123.91	91.10
June	270.0	1.09	268.91	290.00
July	130.0	1.09	128.91	120.00
August	50.0	1.09	48.91	41.20
September	35.0	1.09	33.91	34.50

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[1] Source: Based on R.T. Agar, Jardine Joint Venture, pers. comm., February 18, 1986.

[2] Remainder of column 3 subtracted from column 2.

[3] Source: Peterman and Nelson, 1985.

[4] All figures in cubic feet/second.

APPENDIX 26

THREATENED AND ENDANGERED SPECIES BIOLOGICAL EVALUATION
OPERATING PLAN - HOMESTAKE (JOINT VENTURE)
DRAFT ENVIRONMENTAL IMPACT STATEMENT

MONTANA DEPARTMENT OF STATE LANDS
GALLATIN NATIONAL FOREST

By: J.T. Light
Gallatin National Forest
U.S. Forest Service
January 31, 1986

INTRODUCTION

This biological evaluation 1) provides a list of threatened and endangered species, 2) describes the habitat, distribution, and status of listed species, 3) discusses the effects and consequences of the proposed operating plan on the listed species, and 4) recommends modifications with management practices if aspects of the proposal are inconsistent with the recovery objectives for the listed species.

Federal law prohibits the U.S. Forest Service from authorizing any project or program that would jeopardize the continued existence of a threatened or endangered species. This biological assessment is the vehicle for determining effects on the listed species. A determination of "may adversely effect" via this evaluation will be resolved through formal consultation with the U.S. Fish and Wildlife Service and negotiations with the Jardine Joint Venture. The Fish and Wildlife Service's biological opinion will contain a determination of "jeopardy/non-jeopardy" effect on listed species.

LISTED SPECIES AND HABITAT DESCRIPTION

Those species listed for this assessment by the U.S. Fish and Wildlife Service (pers. comm., 10/19/84) will be the subjects of this biological evaluation. In the assessment area (Figure 1), there are no plant species listed, or proposed for listing, by the Endangered Species Act (1973). The species and their classified status are listed below:

Species	Classification	Status
Grizzly bear	Threatened	Resident
Bald eagle	Endangered	Winter resident
Peregrine falcon	Endangered	Migrant - reintroduction in progress in NW quarter of the Greater Yellowstone Area (GYA)
Gray wolf	Endangered	No known pack; individuals' presence is unknown

Following is a condensed description of the status and habitat of these species in and adjacent to the assessment area. A more detailed description

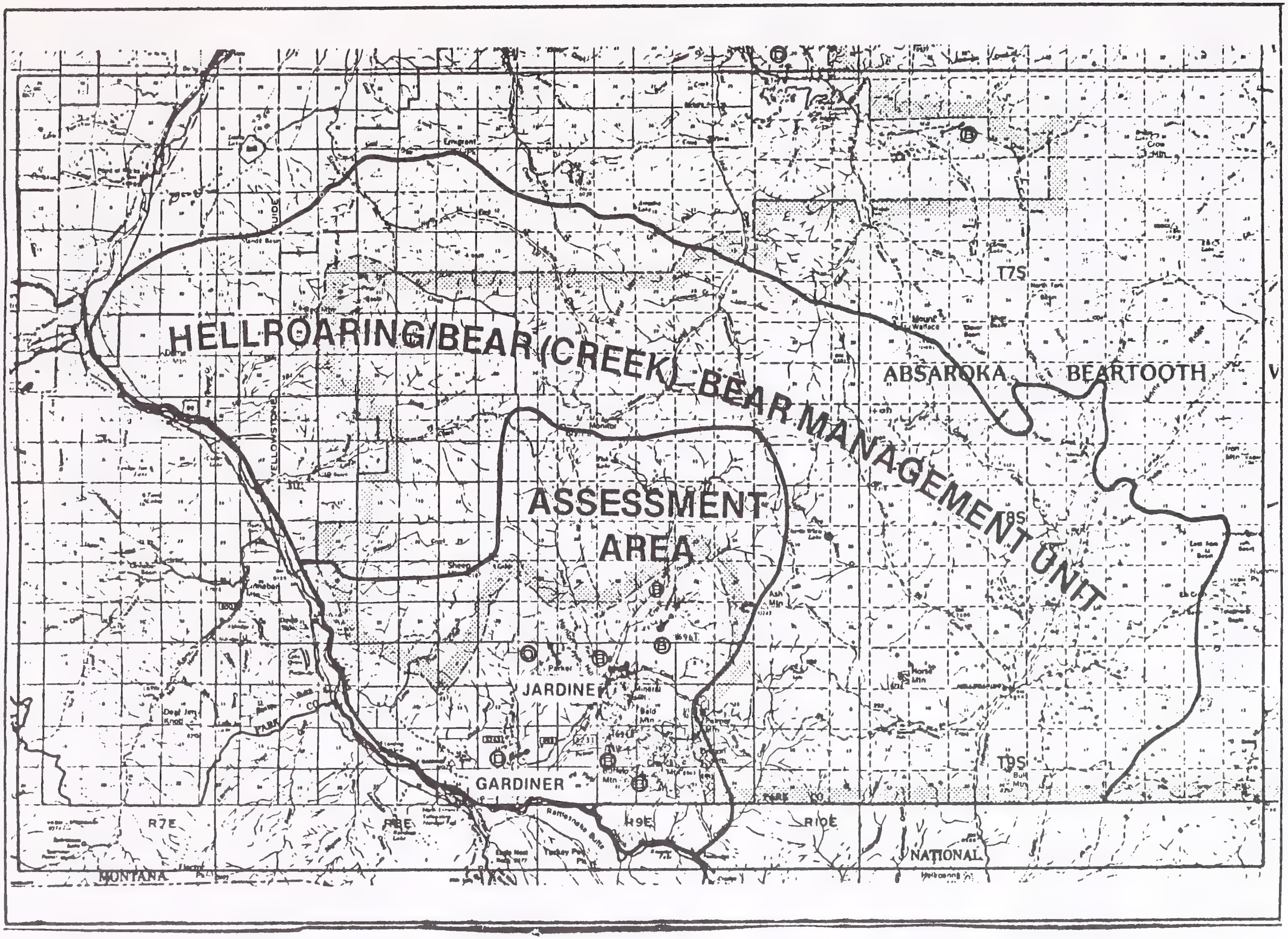

Figure 1: The proposed project would take place within the "threatened and endangered species" assessment area shown here. This assessment area is part of the Hellroaring/Bear (Creek) Bear Management Unit.

is contained in the Jardine Joint Venture Project Draft Environmental Impact Statement (Montana Department of State Lands and U.S. Forest Service, 1985).

Grizzly Bear

The assessment area is in a grizzly bear "high density" zone (Knight and Eberhardt, 1985). Home range polygons of radioed grizzlies in the GYA vary from 105 square miles (average for females) to as much as 1,000 square miles (U.S. Fish and Wildlife Service, 1982). Therefore, the likelihood of grizzly occurrence in the project area is and should continue to be high.

The Interagency Grizzly Bear Study Team (IGBST) has fitted numerous grizzlies with radio collars to determine distribution, habitat use and population trends. Grizzly bear home range polygons established by radio telemetry during the period 1980-1982, indicated that three female bears (#50, #76, and #77) included the assessment area in their home range. These bears were relocated to Yellowstone National Park.

During the late summer and fall of 1984, flight reports indicated that marked grizzlies (#67, #119, and #120) utilized Cedar, Little Trail, and Bear Creek portions of the assessment area (IGBST, 1984).

Within the Greater Yellowstone Area, grizzly bear habitat use is understood from the Craighead's work of the sixties and today's studies by the Interagency Grizzly Bear Study Team. The IGBST is currently completing preliminary analysis of grizzly habitat use based on standardized cover types and standardized forest and nonforest habitat types. The data indicate that grizzly bears within the GYA make extensive use of both forested and nonforested habitat types. These habitat types have importance both for foraging value and cover needs. Mapping of stands of similar vegetation type indicates the abundance and distribution of plant species of concern, such as those used as food by grizzly bears, and gives an indication of the vegetative value of an area to the grizzly bear.

A summary of grizzly bear habitat descriptions (pp. II-50 to II-53, Jardine Joint Venture Project, DEIS) indicates that the assessment area contains suitable year-round grizzly bear habitat. Denning habitat is available at upper elevations in the north and east portions of the area. Post denning and pre-greenup habitat is provided by the grassland and sagebrush ridges and benches at lower elevations. Summer-autumn habitat consists of subalpine fir and whitebark pine habitat types at elevations above 7,600 feet. The Douglas-fir habitat types provides cover adjacent to winter ungulate feeding sites in the assessment area.

In addition to natural habitat, human habitation areas (townsites, homesites, and campgrounds) provide an artificial food source that is especially attractive to the grizzly from late summer through late fall. Grizzly bear movements into the Gardiner-Jardine area has triggered bear management actions resulting in bear mortalities or the removal of grizzlies from the assessment area.

The Jardine Joint Venture Project DEIS (pp. II-46 to II-50) discusses grizzly bear use in the assessment area and grizzly/human conflict that resulted in bear management actions. The grizzly bear management actions (Table II-17, Jardine Joint Venture Project, DEIS) that resulted in losses of grizzlies from the Yellowstone area are significant to the continued existence and recovery of the grizzly bear in the Yellowstone area.

Shortages of natural foods caused by climatic conditions (mild 1980 winter, dry 1981 summer) resulted in relatively high observability of grizzly bears through the GYA. It also resulted in increased human/grizzly encounters in the assessment area. In the 15-year period of reported mortalities (Knight et al., 1976-1982), the assessment area's contribution was equal to or in excess of its aerial proportion of occupied habitat in the GYA. This relatively high level of mortality was due to the intensive human use of the assessment area occurring when climatic conditions prompted grizzlies to expanding their foraging areas.

Bald Eagle

Swenson (1975) did not report any bald eagle nesting territories in the northern third of Yellowstone National Park or in the assessment area. There is evidence of a historical osprey or bald eagle nesting territory in the lower reach of Bear Creek, south of Jardine.

From December through March, bald eagles winter along the Yellowstone River from Livingston to the Gardner River. The availability of fish in the open water along the river is a major attractant for the bald eagles. Another significant attractant is the ungulate carrion made available by natural winter kill and the special winter elk hunts.

Figure II-20 (Jardine Joint Venture Project DEIS) shows locations 28 separate observations of 49 bald eagles during the winter of 1981-82. These bald eagles were foraging primarily on elk carrion in the assessment area. Eleven bald eagles were sighted in a communal roost along Bear Creek. A hunter reported another communal roost on a ridge north of Phelps Creek during the special winter elk hunt of 1984-85.

The significance of the bald eagle in this evaluation is their use of ungulate carrion and roosting sites in the assessment area. The lower half of the assessment area is selected by bald eagles for ungulate carrion availability.

Peregrine Falcon

Confirmed observations of the peregrine falcon have been reported in Gallatin National Forest during spring and fall migrations. A migrant peregrine falcon was observed flying over a big sagebrush/grassland habitat type in the assessment area on March 19, 1982 (Westech, 1984). One natural nest site has been re-established by a wild pair of peregrine falcon in the northern portion of the Yellowstone National Park (M. Meagher, National Park Service, pers. comm., 1985).

The peregrine falcon seeks prey that are dependent on aquatic and riparian habitats. In the assessment area these habitats are limited to along the Yellowstone River and the wetlands southeast of Blanding Guard Station.

There are suitable nesting cliffs in the assessment area. Other known suitable cliffs are north (Cedar Creek) and west (Reese and Stevens Creek in Yellowstone National Park) of the assessment area. These cliff eyries have been utilized by prairie falcon in the recent past. Potential nesting sites exist south of Bear Creek along the Yellowstone River.

The significance of the peregrine falcon in this evaluation is limited to maintaining wetland habitats in the assessment area as a source of avian prey for the falcon. As the reintroduction program progresses into the Yellowstone River basin, these avian prey and nesting habitats will become increasingly important for the recovery of the peregrine.

Gray Wolf

Weaver (1978) found that resident wolf packs were probably eliminated from the Yellowstone National Park in the 1920s. At present, there is no viable pack of wolves. The gray wolf's primary prey base is elk. The large Northern Yellowstone elk herd that moves annually through the assessment area during the winter would be a potential source of prey for a pack of gray wolves. However, private lands north of Yellowstone National Park contain areas of intensive human use that would make habitat undesirable for gray wolf recovery.

The Gallatin's Draft Forest Management Plan provides for an increase in elk numbers. Therefore, all other management practices for other land uses in the assessment area will be oriented to maintain winter range for the elk through cover and road use management on public lands. This management emphasis would also be consistent with gray wolf recovery, should reintroduction become imminent.

CURRENT USE AND PROPOSAL

Current Uses and Activities

Current use of the assessment area baseline includes both non-recreational and recreational type of uses. The wildlife study (Westech, 1984) discusses these activities in greater detail. Table 1 summarizes the land use and recreational activities in the assessment area. These activities will be graphically displayed on map overlays and evaluated by season for their effect on grizzly bear habitat effectiveness as part of the Cumulative Effects Analysis process.

Table 1 does not include the day-to-day commuting traffic between Jardine and Gardiner. The average daily traffic on the Jardine Road has been estimated at 233 (Jardine Joint Venture DEIS, p. II-97).

The baseline population forecast for the Gardiner area for 1985 to 2010 is 1,300 to 1,550 people, respectively. The total increase in Park County population resulting from the Jardine Mine would be 112-262 people. Housing for this many people would be shared between Gardiner and Livingston, Montana.

Table 1--Human Activity in the Jardine Wildlife Study Area, 1981-82

Category	On Road	Off Road	Percent of Observations	Remarks
Cross-country skiing		x	1.3	
U.S. Forest Service activities	x	x	1.4	Weed spraying, tree planting, trail maintenance, other activities.
Horse packing		x	1.9	Non-hunting
Hiking/fishing		x	2.5	Non-hunting
Firewood/logging	x		3.2	
Nonconsumptive Recreation	x		3.8	
Camping	x	x	10.8	Non-hunting
Antler collecting		x	17.3	
Hunting	x	x	57.3	Bow hunting, rifle hunting, camping, and associated horse packing.

Source: Westech, 1984.

The current annual activities that have the greatest potential for affecting listed species are those that occur in areas that are essential for the species welfare (Table 2).

Generally, day-to-day human activity influence zones are avoided by grizzly bears. Such influence zones include the county road, town sites, and seasonally high use trails, roads, and campgrounds. The Grizzly Bear Guidelines for the Gallatin National Forest (1984) provide standards for coordinating land use activities and bear management on National Forest land. In these guidelines, nuisance bears in private land (and townsites) and designated campgrounds will be controlled as in Management Situation III (MS3) by the state. The management of bear attractants on private lands is the responsibility of private citizens and is essential to reducing the potential for bear/human confrontation.

Table 2. Current Activities and Their Potential Effects on Threatened and Endangered Species

Species	Effect	Critical Period	Activity
Bald eagle	Positive	Winter	Special winter elk hunt
Grizzly bear	Negative	Post-denning	Antler collecting
	Neutral	Winter	Winter elk hunt
	Negative	Fall and pre-denning	Bird hunting, bow hunting, and regular big game hunting season.

Proposed Activities in the Mine Operating Plan

The Jardine Joint Venture's operating plan (1984) is summarized below. Only those proposed activities and habitat modifications that would have a potential effect on listed species are described.

Activity Modification	Area Affected
Permit area	410 acres
Type of mine	Underground with 7 miles of tunnels
Production per day	1,050 tons of ore
Duration	Two 8-hour shifts in 5-day week
Land affected	
Total acres	93 acres
Mill area	12 acres
Waste rock dumps	8 acres
Tailing pond w/slurry	61 acres
Mine and facilities	8 acres
Soil stockpiles	4 acres
Milling amount/day	750 tons
Manpower	
Local hire	120 persons
Nonlocal hire	30 persons

Provisions for storing, preparing and serving food are not proposed in the mine operating plan. Solid waste disposal will be transported to Park County landfill sites as required by the county.

EFFECTS OF THE PROPOSAL

The following is an analysis of effects of the proposal on listed species. Following the analyses are mitigating measures designed to lessen impacts.

Noise

Disturbance resulting from noise may affect listed species near the mine. Projections of noise levels from the proposed mill are presented in Table III-26 of the draft EIS and below.

Activity	Duration	Decibels
Construction of mine	18 months	Unknown
Mine/mill operations	24 hours/day 5 days/week for 20 years	89 at mill site 46 at 1,280 feet from mill site

Noise from mining is expected to initially displace grizzlies. The bears would retreat to those habitats where they could not hear mining noises. A reasonable estimate of this distance is one-half mile. Eventually, some grizzlies would become accustomed to mining noise. These habituated bears may begin to re-use the permit area. Furthermore, topography, distance, and forest vegetation would reduce noise by an unknown amount.

Habitat Alteration

Effects would include facilities in the permit area that would modify habitat essential to the welfare of threatened and endangered species.

The permit area includes the town of Jardine. The proposed tailings dump site will eventually cover 61 acres of habitat over a 22-year period. The tailings dump site will include most of an existing tailings site. The company will remove the rest of the existing tailings during mining. The proposed site currently includes elk winter range and early spring grizzly bear habitat. There would be a loss of spring grizzly bear habitat of less than one percent of National Forest land in the assessment area. This loss would not be considered significant. The proposed mining operation plan provides for ongoing reclamation of the tailings dump site at a rate of 2.3 acre per year.

There will be no effects on peregrine falcon habitat.

Effects of Tailings

The tailings would consist of about 95 percent bulk float tailings and about 5 percent cyanide tailings. The bulk tailings would contain arsenopyrite. The cyanide tailings would contain relatively high levels of pyrite, manganese, arsenic, and cyanide. The tailings create a potential for grizzly bears to be poisoned if they consume tailings, seepage water, or contaminated animals. However, many unknown factors preclude a conclusive prediction. These unknown factors are metal toxicities, attractiveness of salts in the tailings to grizzlies and other animals, relationship between grizzlies and salt, and dosages. The anticipated initial avoidance reaction of grizzlies and incremental reclamation would reduce the potential for poisoning. Monitoring would allow for early detection of possible problems.

Seepage from the proposed dump site will be collected in a small collection pond below the tailings dump site. The amount of toxic substances in the seepage that is expected to be collected in this pond has not yet been determined. However, water in the pond will have leached through tailings that contain potentially toxic materials. The concern is that waterfowl could be contaminated. These waterfowl could be consumed by threatened and endangered species. The contaminants could subsequently poison the listed species.

Mitigating Measures

--Erect a 7- to 7-1/2 foot tall woven-wire fence around the seepage collection pond.

--Monitor for waterfowl entry into the seepage collection pond.

--The applicant will be required to submit a plan designed to monitor mule deer, elk, and grizzly bear use of the tailings dump area. The plan would be subject to approval by the permitting agencies. If the agencies determine that deer, elk, or grizzlies are consistently using the dump area or appear to be consuming tailings, a 7- to 7½-foot, woven-wire fence will be constructed around the exposed tailings. In addition, if any animal poisonings can be conclusively attributed to tailings consumption, the fence will be required.

Potential for Illegal Killing

The potential for mortality through illegal killing would increase via issuance of the permit. To compensate, Jardine Joint Venture proposes to: 1) post applicable federal and state hunting, fishing and recreation use regulations, 2) prohibit the carrying of firearms in the permit area, 3) prohibit the harassment of wildlife in the permit area, and 4) cooperate with state and local law enforcement officers. In addition, Jardine Joint venture is philosophically committed to reducing or eliminating the potential for grizzly/human conflicts.

Mitigating Measures

--Jardine Joint Venture will be required to post in the permit area a sign with the following statement:

> The area encompassed by this permit is within the recovery area of the grizzly bear. The grizzly bear is classified as threatened under the Endangered Species Act. Human/bear conflicts have been, and will continue to be, the major factor preventing recovery of grizzly bear populations. Therefore, all activities authorized by this permit are to be conducted in a manner which will prevent or minimize the opportunity for conflicts with the grizzly bear. Violations dealing with prevention of human/bear conflicts, intentional or negligent acts which result in the injury or death of a grizzly bear and other listed species, or other violations of the Endangered Species Act (1973) can result in the criminal actions taken against the violator and holder of the permit.

> The Forest Service, as a federal agency, is mandated to conduct its management activities and authorize only those activities that will promote recovery of all endangered and threatened species.

Power Lines

The applicant has requested that the Montana Power Company design the necessary power lines using the criteria in Olendorff et al (1981). This design would reduce the potential for collision and electrocution of the bald eagle and peregrine falcons with the power transmission lines.

Other Impacts

Other effects of mining and associated activity include those that could affect the availability of food and grizzly bear behavior, i.e., 1) habituation to noise and activity levels, and 2) attraction to human and domestic foods. These effects, unless mitigated, could lead to loss of grizzly bears by direct mortality or relocation of the species from the GYA.

The proposed operating plan does not provide for ore hauling by heavy trucks to the highway at Gardiner. The ore will be milled in the permit area. Use of the county road between Gardiner and Jardine is expected to rise above normal use due to employee commuting and construction-related traffic. This increase would raise the probability of wildlife road kills. Road kills would also increase along U.S. 89 where commuter traffic would rise. The period of major ungulate use of this area, between November 15 and May 15, would provide the highest potential for wildlife road kills. Bald eagles feed on ungulate carrion during the winter and grizzly bears seek this available food source following emergence from their dens in the early spring.

Carrion (dead animals) on or within sight of the road would increase the potential for killing of bald eagles and grizzly bears by accidental collision and/or illegal shooting. However, the Forest Service, Montana Department of Highways and Montana Department of Fish, Wildlife and Parks are currently committed to removing carrion. Their continuing efforts would keep most carrion off the road.

Activities at the mine, such as shift changes and milling noise could cause avoidance of some feeding areas by the grizzly bear and bald eagle. It is anticipated that bald eagles and grizzly bears will initially avoid the milling noise by avoiding the permit area during the day. Since these species presently do not rely on the town of Jardine for habitat, additional displacement would have little additional affect.

Except for the post-denning habitat for the grizzly bear there are no habitats critical to the welfare of threatened and endangered species.

The proper handling and storage of bear attractants, such as sewage, solid waste, pet and livestock food, game meat, fruit trees, and domestic foods, is essential to reducing grizzly bear losses in the assessment area. These losses could result from grizzly bears becoming habituated, after successfully obtaining available domestic foods and human foods. Once habituated to human foods, they will become nuisance bears requiring control action which could lead to removal from the assessment area or the Greater Yellowstone Area.

Mitigating Measures

--The Jardine Joint Venture's operating plans (1984) provide for a "drive-park-pool" program between Gardiner and Jardine that would be mandatory for management personnel and optional for non-management employees.

--The applicant's plans (1984) provide for a reduction in speed limit within the permit area to reduce the potential for vehicle and wildlife collision.

--Gallatin National Forest and the Montana Department of Highways will finalize a program designed to remove carrion from highways in grizzly bear range. This plan will include U.S. 89 between Gardiner and Tom Miner Basin (western boundary of a Gallatin National Forest Bear Management Unit).

--The Jardine Joint Venture operating plan (1984) provides that "all garbage produced within the permit area will be hauled to receptacles in Gardiner, or directly to the solid waste disposal facility in Livingston. Homestake Mining Company officials will confer with the Montana Department of Fish, Wildlife and Parks, U.S. Forest Service, and other relevant parties to ensure that temporary garbage storage facilities in the permit area are bearproof, and that transport of garbage to Gardiner or Livingston is timely and will avoid accumulation within the permit area." The applicant will be required to abide by U.S. Forest Service recommendations regarding garbage disposal on the permit area.

CUMULATIVE IMPACTS

Cumulative impacts are the incremental impacts of the proposed action when added to past, present, and reasonably foreseeable future activities in the area. Other activities could amplify the negative effects of mining. Some of these activities include developed and dispersed recreation, antler collecting, game hunting, timber sales, and activities along trails and roads (see Table 1). The analysis of cumulative impacts on threatened and endangered species considers all activities within the assessment area (fig. 1). These impacts would combine with mining to increase pressures on threatened and endangered species in the analysis area. In the case of this study, the grizzly bear would be the species most affected by cumulative impacts in the Bear Management Unit.

For 80 percent of the year, recreational use is at a low level. During the hunting season (20 percent of the year) use rises to moderate to high levels. Projected recreational use resulting from the mining activities are not expected to increase significantly over existing levels.

The U.S. Forest Service proposes to conduct small timber sales in the assessment area. These sale, affecting 25 acres per year from 1987 through 1996, would combine with mining to increase impacts on grizzly bears.

Although shorter in duration, direct impacts caused by these timber sales would be similar to mining impacts: grizzlies would experience temporary habitat loss, displacement, increased chances for conflicts with humans, and increased possibilities of being poached.

Over the next 10 years, logging could affect about 250 acres of grizzly bear habitat. This acreage would be at least 10 non-continguous cutting units of less than 25 acres per year. Cutting units would be designed for long-term grizzly bear habitat improvement. Logging would encourage growth of plants important for grizzly bear consumption. Quality cover habitat would be maintained.

Chances of poaching or grizzly/human conflicts because of logging would be fewer than the chances caused directly or indirectly by mining because of the small number of loggers (Jardine Joint Venture DEIS, p. III-52). Also, indirect impacts are not anticipated because logging would only slightly increase the human population.

Grizzlies may become accustomed to logging activity. This would benefit the grizzlies by allowing them to use habitats adjacent to logging sites; however, the negative effect in this case would be increased chances for confrontations between grizzly bears and people.

Changes in the Yellowstone area's grizzly population resulting from human/grizzly conflicts cannot be reliably predicted. Although chances for these conflicts would increase, there is no way to predict the frequency of encounters. The variation in bear management actions and in grizzly behavior further complicates prediction capabilities. The effects of all recreational and development activities in the assessment area and the entire Hellroaring/ Bear Creek Bear Management Unit (BMU) will be quantitatively assessed by the Cumulative Effects Analysis (CEA) process. The draft EIS recognizes that there is a potential for a slight increase in recreational activity in the BMU as a result of the proposed action. Cumulative impacts will be evaluated and managed by the cumulative effects analysis process in the following manner:

1) Based on observed population and existing habitat data, the following objectives for the entire assessment area and Bear Management Unit are recommended.

   Complete habitat analysis utilizing the Cumulative Effects model and implement interim threshold levels as a working hypothesis until biological thresholds for each Bear Management Unit are developed. The following interim thresholds were agreed upon for implementation by the Yellowstone Subcommittee of the Interagency Grizzly Bear Committee and should be met within occupied habitat of the assessment area.

   Interim Biological Thresholds

   Habitat Effectiveness - Within each bear management unit and/or subunit, habitat effectiveness values at a minimum should be retained at the current level, with no decreases. However, when the current level is below 80 percent of potential habitat effectiveness, a minimum goal of reaching 80 percent is essential. Habitat effectiveness will be measured on a seasonal basis and not aggregated in order to safeguard against losses of seasonally significant habitat.

Mortality Index - It is readily accepted the man-caused grizzly bear mortality, particularly in the adult female segment, is key to maintaining the grizzly bear population in the Greater Yellowstone Area. With this in mind, it is recommended that the mortality index goal for each bear management unit and/or subunit be established at no increase above existing levels. Decreasing the existing mortality, particularly resulting from point source activities should be the target goal in light of recent population trends.

2) Based on grizzly bear use data and habitat suitability from grizzly bear component mapping, restratify management situations from MS-2 to MS-1. The patented mining area and private land in vicinity of Jardine and Gardiner will be managed as in MS-3. This will be accomplished via the forest management planning process.

At this time, no mitigating measures are planned for resolution of effects to be determined by the CEA.

BIOLOGICAL EVALUATION

It is the evaluation of the U.S. Forest Service that the proposed Jardine Joint Venture mining activity in Jardine "may adversely effect" grizzly bear in the assessment area. However, mitigation measures proposed by the permittee and this biological assessment will lessen impacts on the grizzly bear. Landowners in the assessment area could also be encouraged to follow the appropriate mitigating measures that would reduce the potential for grizzly/human conflicts. The "may effect" evaluation is based primarily on the increased potential for encounters between grizzly bears and humans.

The Cumulative Effects Analysis would shed more light on the off-site effects of the proposal. Adjustments in land use activities may be necessary as a result of the Cumulative Effects Analysis to be completed in the future.

It is the recommendation of this assessment that formal consultation be initiated with the U.S. Fish and Wildlife Service.

INFORMAL CONSULTATION

This biological assessment was reviewed informally by the following individuals. Their comments and suggestions are appreciated and were incorporated into this assessment.

Jon Swenson - Montana Department of Fish, Wildlife and Parks
Mary Meagher - Yellowstone National Park
Rob Hazelwood - U.S. Fish and Wildlife Service
Scott McCollough - Montana Department of State Lands

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Addendum to
Threatened and Endangered Species Biological Evaluation
Jardine Joint Venture

Montana Department of State Lands
and
Gallatin National Forest
(February 27, 1986)

1. Page 14: Omit all mitigating measures (retain Jardine Joint Venture proposals).
2. Page 14: Add--Erect a 7- to 7-1/2 foot fence around the return water pond.
3. Page 14: Add--(The applicant would) #5. Use game and fish violation as cause for employee dismissal (R.T. Agar, American Copper and Nickel Company, Inc., pers. comm., January 23, 1986).
4. Page 14: The applicant proposes to build a fence (woven-wire, at least 7 foot tall) around the seepage collection pond. The tailings dump facility would be monitored for use by major animal species. Avian use of the seepage collection pond would also be monitored. If wildlife consistently use the tailings area, the applicant would consult with the Department of State Lands to develop solutions. The applicant's monitoring plan and contingency responses would be subject to approval by the permitting agencies.
5. Page 17: Add--Jardine Joint Venture would report road-killed animals to the U.S. Forest Service or Montana Department of Fish, Wildlife and Parks.
6. Page 18: Revise final mitigating measures--garbage will be transported directly to Livingston (J. Danni, Homestake Mining Co., pers. comm., February, 1986).
7. Page 22: It is the evaluation of the U.S. Forest Service that the proposed Jardine Joint Venture mining activity will result in "no adverse effect" on the bald eagle, peregrine falcon, or gray wolf.

APPENDIX 27

March 3, 1849

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Endangered Species, Field Office
Federal Bldg., U.S. Courthouse
301 South Park
P.O. Box 10023
Helena, Montana 59626

IN REPLY REFER TO:

M.19 Jardine Joint Venture Project
Gallatin NF, 6-1-86-F-002

March 11, 1986

James Overbay, Regional Forester
U.S. Forest Service, Region 1
Federal Building
Box 7669
Missoula, MT 59807

Dear Mr. Overbay:

This is the Fish and Wildlife Service (FWS) biological opinion prepared in response to your February 6, 1986 request for formal consultation on the effects the proposed Jardine Joint Venture Project will have on the grizzly bear (Ursus arctos horribilis). The FWS has examined the proposed project in accordance with Section 7 Interagency Cooperative Regulations (50 CFR 402, 43 FR 870) and the Endangered Species Act of 1973, as amended (ESA). This biological opinion refers only to the potential effects on the grizzly bear and not the overall environmental acceptability of the proposed action.

Project Description

The Homestake Mining Company and the American Copper and Nickel Company have filed joint venture plans with the Montana Department of State Lands and the Forest Service to build a new mill and underground gold mine, known as the Jardine Joint Venture Project (JJV) on the west side of Mineral Hill above Jardine, Park County, Montana. According to the JJV application, mine construction could begin as early as the spring of 1986. The mine could be fully operational in mid-1988. Yielding an average of 1,050 tons of ore per day, five days per week, the mine has an estimated life of 20 years, through 2008. The gold would be concentrated and refined in the mill. The mill would process about 750 tons of ore per day, seven days a week. Most of the ore would leave the mill as waste-product tailings. These tailings would be deposited in a sealed disposal area within a mile of the mill or backfilled into the mine. The project would last for at least 22 years, including 18 months of construction, 20 years of production, and at least one year of final reclamation.

The project area encompasses 410 acres, of which only 93 acres would be disturbed by construction and operation. The permit area would cover parts of the northeast, northwest, and southwest quarters of Section 9 and southeast quarter of Section 8 of T9S, R9E. Most of the disturbance would be on private land owned by the applicant. Only a small area of Forest Service land would be covered by tailings. About 28 percent (102 acres) of the proposed disturbance area has been disturbed by previous mining.

Biological Opinion

It is the FWS biological opinion that implementation of the proposed JJV project with inclusion of all compensative measures described in the February 6, 1986 biological assessment and February 26, 1986 addendum to the assessment, is not likely to jeopardize the continued existence of the grizzly bear. In addition, we concur with your no affect determination on the bald eagle, gray wolf and peregrine falcon.

Basis of Opinion

Grizzly Bear

To assure the viability of the Greater Yellowstone grizzly bear population and habitats, activities that take place in grizzly bear occupied habitat must be at a level and conducted in a manner to insure that (1) bears are not adversely impacted directly, indirectly or cumulatively; (2) important habitat components are not adversely modified or destroyed; (3) that sufficient space to accommodate grizzly recovery is left undisturbed from detrimental human activities to meet the biological requirements of the bears; and (4) that activities are designed and coordinated to primarily minimize the potential for grizzly/human conflict that could result in mortality or relocation of grizzly bears. The lands allocated to grizzly bear habitat management on the Gallatin National Forest and stratification of occupied grizzly bear habitat into Management Situations and implementation of their attendant guidelines provides a process to assure that the above objectives are met. The JJV project falls within a Management Situation 3 area, as defined by "Guidelines for Management Involving Grizzly Bears in the Greater Yellowstone Area".

In most Situation 3 areas, grizzly presence is possible but infrequent. In this case, the assessment area is in a grizzly bear "high density" zone (Knight and Eberhardt, 1985), and contains suitable year-round grizzly habitat. Management direction for Situation 3 habitat states that grizzly habitat maintenance and improvement are not management considerations. The FWS prescribes to the guideline direction in this consultation, however, cumulative impacts in the assessment area remains a concern. Further, guidelines for Situation 3 habitat, places grizzly/human conflict minimization as a high priority for management consideration; this was a major concern in this consultation. Shortages of natural grizzly bear foods caused by climatic conditions can result in increased human/grizzly encounters. In the 15-year period of reported grizzly mortalities (Knight et al., 1976-1982), the assessment area's contribution was equal to or in excess of its areal proportion of occupied habitat in the Greater Yellowstone Area. This relatively high level of mortality was due to grizzly attractants and/or human activities interfering with grizzly use of habitat, particularly when climatic conditions prompts grizzly bears to expand their foraging areas. The compensative measures, which address minimizing human/grizzly conflicts were adequately addressed in the DEIS, biological evaluation and addendum, and are as follows:

1) The Jardine Joint Venture operating plan (1984) provides that "all garbage produced within the permit area will be transported directly to the solid waste disposal facility in Livingston, Montana. Homestake Mining Company officials will confer with the Montana Department of Fish, Wildlife and Parks, Forest Service and other relevant parties to ensure that temporary garbage storage facilities in the permit area are bear-proof, and that transport of garbage to Livingston is timely and will avoid accumulation within the permit area". The applicant will be required to abide by Forest Service recommendations regarding garbage disposal on the permit area.

2) The Jardine Joint Venture's operating plans (1984) provide for a "drive-park-pool" program between Gardiner and Jardine that would be mandatory for management personnel and optional for non-management employees.

3) The applicant's plans (1984) provide for a reduction in speed limit within the permit area to reduce the potential for vehicle and wildlife collision.

4) Gallatin National Forest and the Montana Department of Highways will finalize a program designed to remove carrion from highways in grizzly bear range. This plan will include U.S. 89 between Gardiner and Tom Miner Basin (western boundary of a Gallatin National Forest Bear Management Unit).

5) JJV would report road-killed animals to the Forest Service and/or Montana Department of Fish, Wildlife and Parks.

6) Any fish and/or game violation would be cause for employee dismissal.

To compensate for the potential for mortality through illegal killing, the JJV proposes to:

1) Post applicable Federal and State hunting, fishing and recreation use regulations.

2) Prohibit the carrying of firearms in the permit area.

3) Prohibit the harassment of wildlife in the permit area.

4) Cooperate with State and local law enforcement officers.

In addition, Jardine Joint Venture is philosophically committed to reducing or eliminating the potential for grizzly/human conflicts and will be required by the Forest Service to post a sign with the following statement:

> The area encompassed by this permit is within the recovery area of the grizzly bear. The grizzly bear is classified as threatened under the Endangered Species Act. Human/bear conflicts have been, and will continue to be, the major factor preventing recovery of grizzly bear populations. Therefore, all activities authorized by this permit are to be conducted in a manner which will prevent or minimize the opportunity for conflicts with the grizzly bear. Violations dealing with prevention of human/bear conflicts, intentional or negligent acts which result in the injury or death of a grizzly bear and other listed species, or other violations of the Endangered Species Act (1973) can result in the criminal actions taken against the violator and holder of the permit.
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> The Forest Service, as a Federal agency, is mandated to conduct its management activities and authorize only those activities that will promote recovery of all endangered and threatened species.

Another area of concern in this consultation was that the tailings from the mine could create a potential for listed species to be poisoned, either directly or indirectly. Compensative measures have been adequately described and are as follows:

1) A seven (7) to seven and one-half (7 1/2) foot fence will be erected around the return water pond.

2) The applicant proposes to build a fence (woven-wire, at least seven (7) foot tall) around the seepage collection pond. The tailings dump facility would be monitored for use by major animal species. Avian use of the seepage collection pond would also be monitored. If wildlife

consistently use the tailings area, the applicant would consult with the Department of State Lands to develop solutions. The applicant's monitoring plan and contingency responses would be subject to approval by the permitting agencies.

Conservation Recommendations

1) As previously mentioned in this consultation, cumulative impacts in the assessment area is a concern. The effects of all recreational and development activities in the assessment area and the entire Hellroaring/Bear Creek Bear Management Unit should be quantitatively assessed by the Cumulative Effects Analysis (CEA) process as soon as possible, and prior to any additional activities being considered in these areas.

2) In the event that the garbage produced within the permit area would be transported to the solid waste facility in Gardiner, Montana, the FWS recommends that JJV help pay its share of bear-proofing the Gardiner dump.

This completes the FWS biological opinion on the proposed JJV project. If the proposed plan should change significantly resulting in impacts not considered in this biological opinion, consultation should be reinitiated. Your cooperation and interest in meeting our joint responsibility under the Endangered Species Act is appreciated.

Sincerely,

Wayne G Brewster

Wayne G. Brewster
Field Supervisor
Endangered Species

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